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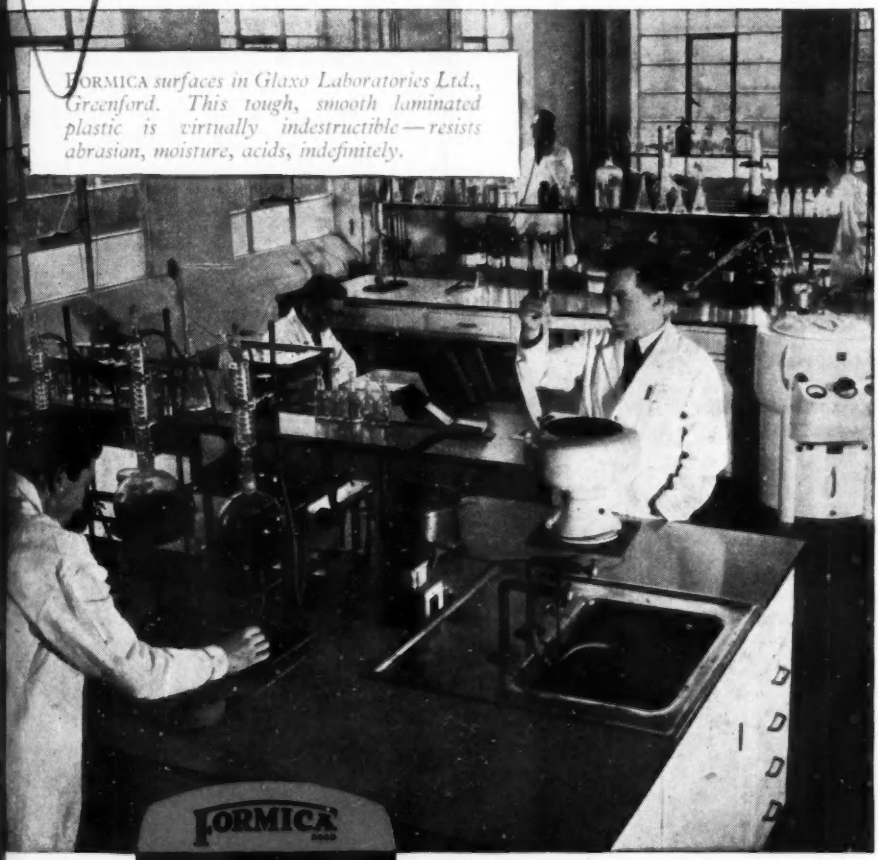

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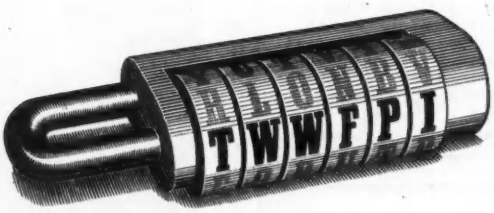

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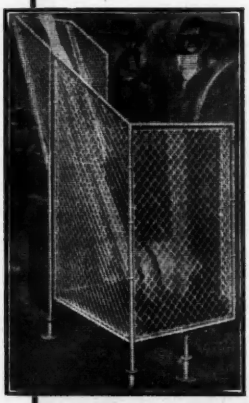

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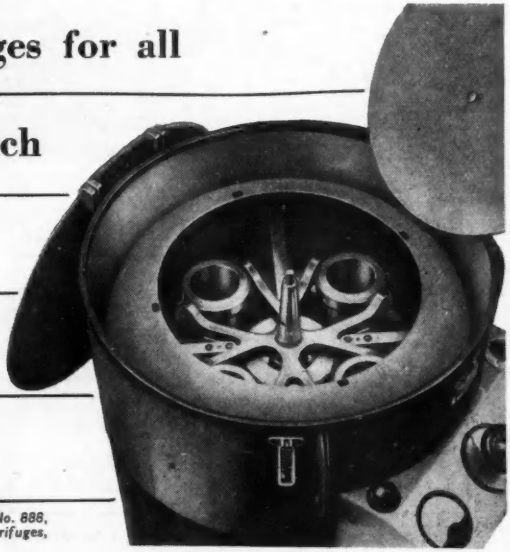

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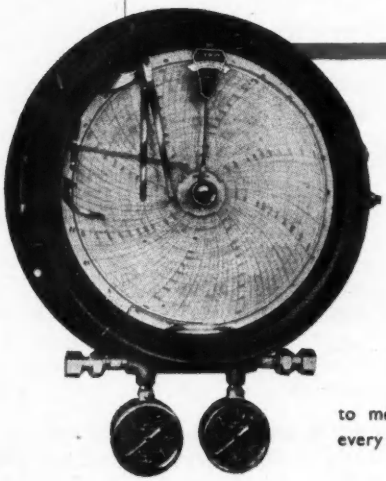

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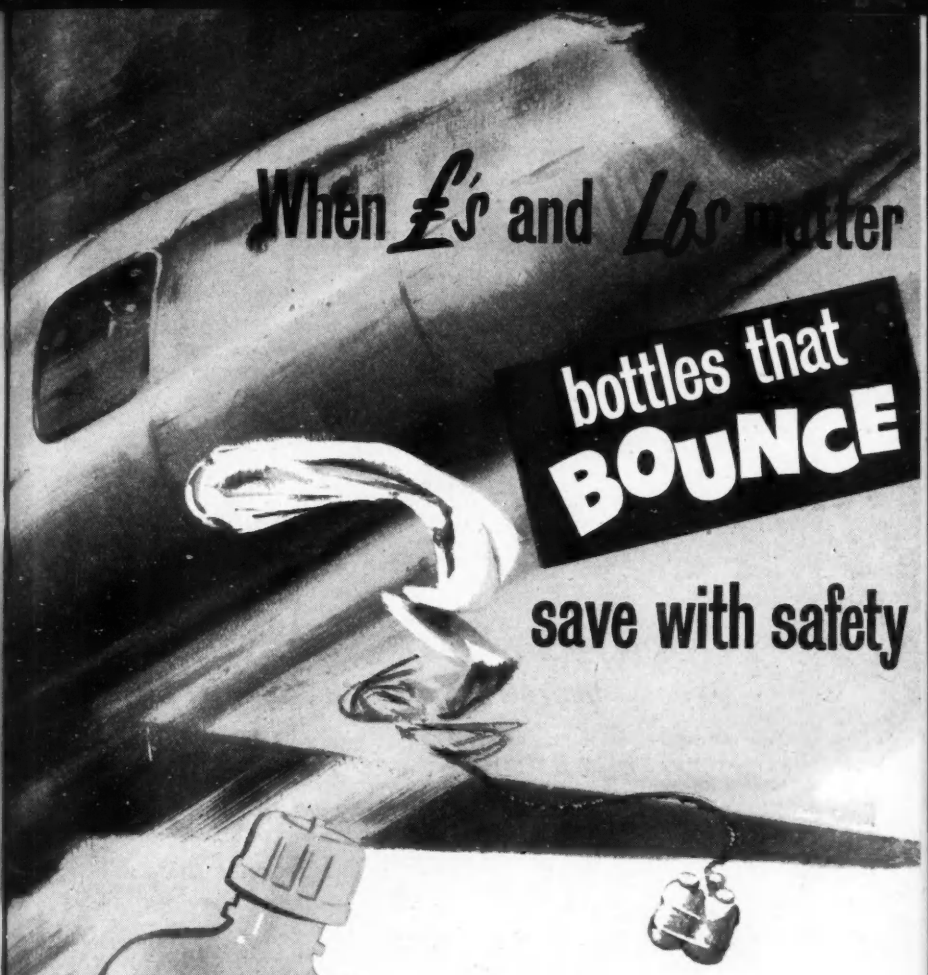

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The Chemical Age
19 July 1952

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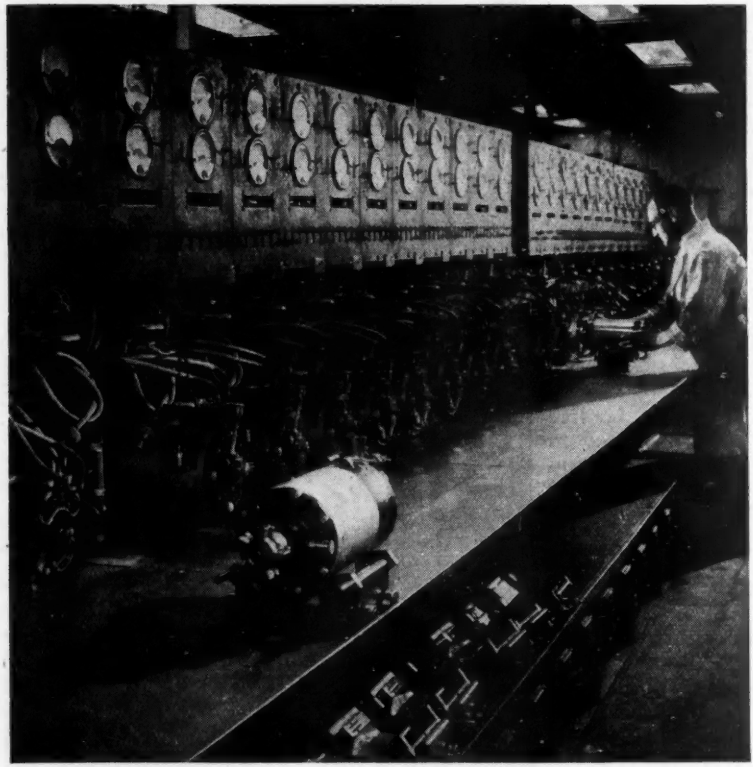

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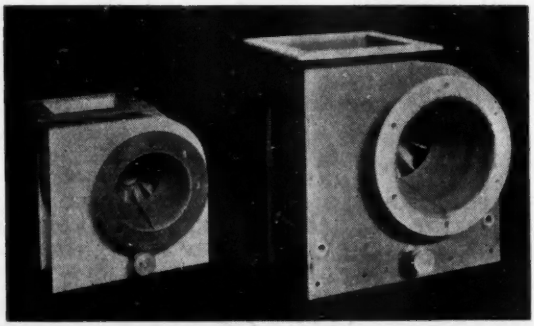

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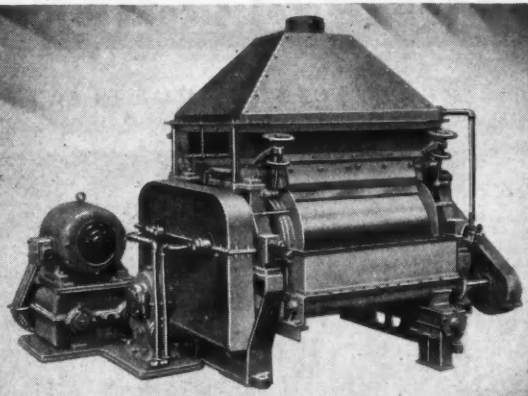

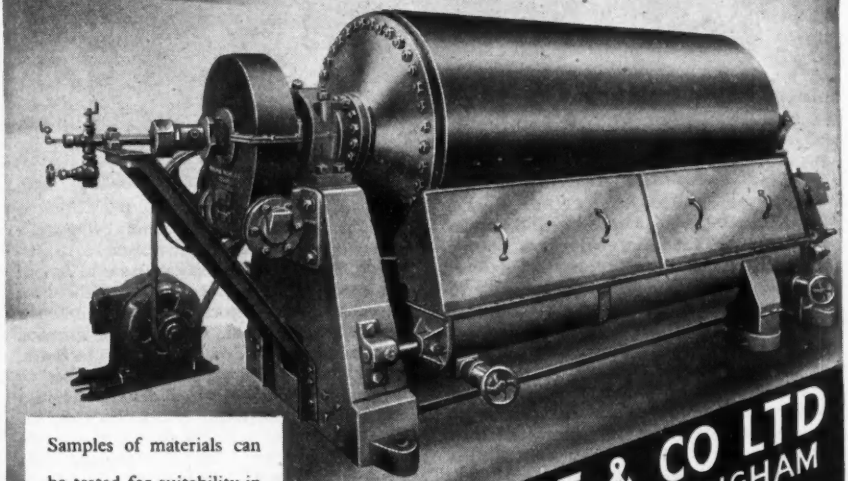

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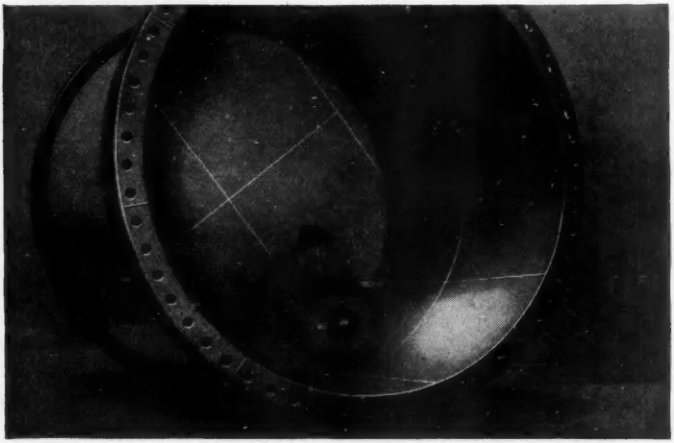

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Volume LXVII 19 July 1952 Number 1723

Untaken Harvest

WE must admit felony in using this title. But what better title could there be for 'man's loss of crops from pest, weed and disease?' Unable to coin any improvement of our own we have been forced openly to steal this title given by Mr. George Ordish to his book, a study of the economic aspects of these losses and of their remedial measures. (*Untaken Harvest*. By George Ordish, Dip.Hort., B.Sc.(Econ.). 1952. London. Constable. 171 pp. 15s.). Indeed, it is impossible not to steal more than this from Mr. Ordish, for in a technical world in which there seems no end to the making of books, he has brilliantly cornered a monopoly of subject and subject-matter. To the best of our knowledge no one else has attempted a modern and comprehensive survey of the economics of crop attacks and of the insecticides, fungicides, and weed-killers available for control. As agricultural economist to Messrs. Plant Protection, Ltd., Mr. Ordish is well fitted by experience to undertake this difficult task; but more impressive still is his natural ability as a writer, which has enabled him to invest with colour and clarity what could so easily have been just an accumulation of facts, costings, and statistics.

'With some ninety years' background of work in this field, the last thirty of a great and increasing intensity, it is surprising that our economic entomologists and mycologists have scarcely studied the questions of how much damage is done by pests, or the cost of controlling them.' Mr. Ordish not only puts his finger on the major gap in the literature of this important technology, but his initial attempt to fill it will not for many a successive book be bettered. How frequently all of us see estimates of this and that percentage loss of crop attributable to the parasitic or competitive influence of this or that organism, be it an aphid species, a mildew fungus, or an annual weed. Yet if we take all these estimates seriously—20 per cent of loss for this and 15 per cent for the other—it seems a miracle of mathematics than any harvest should ever be gathered. Here, indeed, Mr. Ordish mentions the embarrassing case of the young man in the U.S. Department of Agriculture who studied official crop damage surveys from an original and unexpected angle and showed that the 1945 figures suggested that in 1944 the U.S. had grown no wheat or maize at all! The additive approach, as Mr. Ordish rightly stresses, is riddled with fallacy.

Another confusing difficulty in the economics of crop disease and its prevention must be squarely faced. Crop losses tend to increase the price of the effective crop; if prevention of some

particular insect damage adds, say, 250,000 tons to the total national crop, it cannot be argued that this adds 250,000 plus the crop price to the value of produce. With a significantly greater harvest on the market the price per ton will certainly drop. The real loss caused by pests or weeds is found in the use of land, labour, and resources to grow the untaken portions of the harvests. 'In effect over 33,000 farms produce no crop in the United Kingdom' and 'the labour of more than 51,000 skilled farm workers is wasted on account of the ravages of pests.' That is the conclusion reached from a quite conservative survey of our crop damage and losses in 1947.

These are general considerations and in giving them priority of space we must not suggest that Mr. Ordish's book ignores the detailed study of costs in specific plant protecting operations. At least two chapters abound with these data even though changes in technique today are rapidly altering the costs of many control measures. If a spraying programme costs the grower £X per acre and leads (on average measured results) to an increase of £Y in the output value per acre, then the ratio Y/X expresses the direct profitability of the total operation. This ratio may vary according to whether a full or limited control programme has been adopted. Mr. Ordish has tabulated many such ratios for a variety of crops. He deals also with the costs of different methods of applying the same chemical, e.g., dusts, sprays, and even the comparatively new method of distribution from helicopters or fixed wing aircraft. In a narrower sense than that of its main theme, the book has an exceptional reference value, for though such data may be found in countless articles and papers they have not often been critically co-ordinated.

In the absence of sufficient facts and figures, Mr. Ordish has tried to estimate the real value of crops saved in world agriculture and horticulture as a result of the use of chemical pesticides. World trade in these products is about £100 million per year; adding the cost of distribution and the costs of application, farmers must be spending at least £300 million each year on crop protection. They would not do so if the gain was not usefully higher than the cost. Assuming a modest ratio of 2:1—modest because most ratios for specific operations are known to be better—he suggests that the value of crops saved is not less than £600 million per year. Alternatively the world's crop protection industry 'annually secures the rations and textiles of 40 million people.'

This notable book should be widely read. It is an outstanding and realistic contribution to a relatively young and complex branch of applied science, a subject in which its experts often cannot see the wood for trees. There have been a number of scientific books on plant protection but it has fallen to an agricultural economist to bring by far the brightest source of illumination. For many chemists, too, the last chapter—on the history of the trade in pesticides—will have special interest; this again is a subject that has not often been treated.

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Notes & Comments

Chemicals & British Exports

AN illuminating and long-term analysis of Britain's export problems is contributed to the July issue of *Lloyds Bank Review* by Professor Ely Devons of the University of Manchester. He shows clearly that the groups of products that have continued to expand are those which were also tending to expand before the war—vehicles, machinery, electrical goods, cutlery and hardware, non-ferrous metal products, and chemicals. As for chemicals in particular, they now hold a 5.5 per cent share of our total export trade compared with a 4.7 per cent share in 1938. The acute and recent problem of 'terms of trade,' with our import prices rising much more steeply than our export prices, may be caused in some degree by our own failure to put high enough prices on exported goods. Professor Devons points out that in the main groups of British exports the chemical section shows the smallest increase in price over pre-war levels—we are selling chemicals at less than 2½ times the 1938 prices. In general, all products with a relatively low raw material content — e.g., machinery, vehicles, manufactured chemicals—have risen the least in price. Yet in the post-war world these are the goods that in most markets of the world have been in acutely short supply. The writer concludes 'there is apparently some evidence here that export prices of many British products have been kept at an unnecessarily low level.' The indictment, inasmuch as this suggestion can be called that, is, of course, a fairly abstract generalisation. To what extent could it be upheld in the specific case of chemicals? Could we still sell the same expanding volume at higher prices? If so, the time of opportunity has perhaps passed by already. The revival of Japanese competition may not seriously affect world trade in chemicals, but Germany's remarkably rapid recovery cannot fail to make a steadily increasing impact upon our own export trade.

Sewage as a Fertiliser

AN interesting future possibility is discussed in a recent issue of the *Lancet*, concerning fertilisers. This article declares that it may soon prove impossible for this country to import great quantities of nitrogen, phosphorus and potash from Algeria, Chile and the South Seas. When this happens the wasteful practice of allowing so much valuable organic manure and essential elements to flow away down the sewers may have to be very seriously considered. The difficulties of handling such offensive material as human excreta are, of course, very great. The only solution to it is composting, a practice which has been followed mostly by gardeners, but not on a sufficiently large scale to be of much use to agriculture. The resultant manure produced by composting is very valuable indeed, by virtue both of its essential elements and humus, and also of the trace elements. The process advocated by Mr. J. C. Wylie, whose address to the Royal Society of Arts is commented on in the *Lancet*, is to add sewage sludge to domestic or industrial refuse, or to vegetable matter grown for the purpose. Fermentation ensues, heat is generated, and the harmful bacteria are killed. In Dumfries, where Mr. Wylie is county engineer, the process is incorporated in a fairly large-scale scheme, and the finished product sells at 50s. a ton. Manuring is costly, and if this product is of a fine enough texture to spread like a chemical fertiliser, the gain should be considerable. However, before the scheme can become widespread—and the use of bacteria for synthesis, breakdown and other types of chemical change may be the industry of the future—there must be sufficient safeguards to ensure that pathogenic bacteria do not find their way into the product. It would be a pity if a scheme with such wide implications should get itself a bad name at the start simply by over-enthusiasm or an initial lack of proper precautions. An outbreak of typhoid or other epidemic would give the plan a very bad start.

U.K. Competes with U.S. Chemical Exports

Two Countries also Good Customers of Each Other

BRITAIN is not only the best European customer of the U.S. chemical industry, but is also a leading competitor in all export markets, according to Mr. C. C. Concannon, of the U.S. National Production Authority.

Britain increased its purchases of U.S. chemicals from $33,000,000 (about £11,800,000) in 1950 to $50,000,000 (about £17,800,000) in 1951, he says.

But in 1951, the United States bought £11,330,000 worth of British chemicals and became Britain's second largest customer.

Mr. Concannon makes a thorough survey of the world's chemical markets in a special article published by the New York *Journal of Commerce*. He points out that U.S. chemical manufacturers, who have expanded their production in the last two years to meet defence needs, must search for new and greater overseas markets in preparation for the day when defence needs no longer absorb so much of their output.

But many European countries have also greatly expanded their chemical output, he says, and will be competing with the United States for new markets to increase these new rates of productivity.

Britain Leads Europe

'Britain now takes the lead in European petroleum refinery capacity,' Mr. Concannon says, 'and there has been a great increase in carbon black and rubber chemicals. Plastics receive special attention and are being made on a vastly greater scale.

'Expansion of British chemical export trade was larger in 1951 than in any other category of goods chiefly manufactured. Exports of chemicals, drugs, dyes and colours totalled £142,690,000—a 33 per cent increase over the 1950 figure.

'The largest gain was in benzene, which, however, is a temporary development, due to the present world situation. Exports of this product rose to £5,900,000 from £1,600,000 in 1950.

'Other important export commodities were: Soda products, £8,990,000; disinfectants, insecticides and related products, £8,890,000; ready-mixed paints, £6,010,000; and ammonium sulphate, £5,370,000.

'Commonwealth countries continue to be the solid basis of British chemical trade and as a group take the largest amount. India retained its position as the leading single market in 1951, its purchases rising sharply to £11,550,000 from £7,483,490 in 1950.'

Turning to the Continent, Mr. Concannon finds that the German chemical industry, which benefited from unusual world conditions in 1951, has now come back strongly into world markets.

But German chemical exports are still below pre-war levels, he says, although exports are increasing, especially to countries in the Western Hemisphere.

'The German industry is feeling the effects of import restrictions in the United Kingdom, other sterling areas and France, but the situation in Latin America has been especially favourable, in spite of some controls,' he reports.

France is another European country that promises to develop a strong chemical industry, although it is hampered by lack of capital and a reluctance to develop new lines. But this trend is being overcome and many chemicals not previously made are being manufactured now.

Switzerland is also concentrating on the chemical export market with high-quality products and specialised lines.

Italy is trying hard to recover its position in chemical exports, but it has been up against foreign competition and import restrictions overseas. Italy's methane resources are the brightest spot in the industry and hold out great possibilities.

Even though British, German, French and Swiss exporters compete with each other in many markets, they also sell large quantities of chemicals among themselves, says Mr. Concannon.

He predicts: 'The struggle for chemical dollars will be greater than ever before.'

Change of Address

Thomson, Skinner & Hamilton, Ltd., laboratory furnishers, scientific instrument makers and chemical dealers, have now removed to 12 Cadogan Street, Glasgow, C.2. Telephone: CITy 6014.

SCI Chooses American President

Seventy-First Annual General Meeting Held at Aberdeen

THE Society of Chemical Industry enjoyed a busy week of meetings, social functions, works visits and social outings at Aberdeen from 7 to 12 July under the presidency of Dr. John Rogers (chairman of Imperial Chemical Industries, Ltd.), who relinquished the office of president at the end of the meeting and was succeeded officially by Mr. Francis J. Curtis, a vice-president and director of the Monsanto Chemical Company of St. Louis, in the State of Missouri, U.S.A.

The host of the many members and visitors on this occasion, who included many delegates from overseas, and their ladies, was the Aberdeen & North of Scotland Section, one of the youngest of the Society's Sections, having been formed in 1948. Mr. George F. Beecroft (the chairman of the Section), Mr. E. A. Bradford (hon. secretary and treasurer) and their fellow members of the committee there made a team which organised a busy week to the satisfaction and enjoyment of all who attended.

The programme opened with an informal reception in the Mitchell Hall of the Marischal College, at which the guests were received by Mr. and Mrs. Beecroft on Monday evening. There was light music as the guests assembled, refreshments were available, and many of the guests enjoyed dancing between periods of friendly conversation.

The Annual General Meeting

On Tuesday morning, 8 July, the members of the Society assembled, again at Marischal College, for the business of the annual general meeting and to hear Dr. Rogers' Presidential Address.

A cable was received from the Society's American Section, conveying best wishes to the parent Society for a successful meeting and a forthcoming year of great accomplishments, and gratitude for the honour being considered for Mr. Frank Curtis (as President for the ensuing year); and there were messages of greetings from a large number of members of the Society throughout the world.

The annual report of the Council for the year 1951 was presented by the hon. secretary, Dr. E. B. Hughes, who pointed to the fact that during that year the Society had formed three new groups and one new Section. That was an indication of the progress the Society was making; and those new bodies were functioning well and efficiently.

Elected Officers

The following officers were elected for the year 1952-53:—

President, Mr. Francis J. Curtis; *hon. treasurer*, Mr. Julian M. Leonard; *hon. foreign secretary*, Dr. L. H. Lampitt; *hon. secretary*, Dr. E. B. Hughes; *hon. publications sec.*, Mr. F. P. Dunn; *vice-presidents*: Messrs. W. H. Brindley, G. J. Esselen, L. A. Jordan, A. Marsden, H. V. Potter, S. Robson, J. Rogers and H. Greville Smith; *members of council*: Messrs. R. A. E. Galley, A. W. Marsden, F. A. Greene and E. W. Muddiman.

The president, Dr. Rogers, in his address, said that in all walks of life men and women were from time to time honoured in various ways by their fellows and elected to prominent positions. In his case there could be no recognition greater than appointment as president of the Society of Chemical Industry, for he had spent nearly all his life in the industry. He made no claim to great scientific attainments; therefore his contribution, such as it may have been, had doubtless come from the application of the scientific discoveries of others to chemical production. It was not always expected that the greatest scientists were practical people, so that a certain amount of low-brow interpretation was now and then required. There were, of course, many highly gifted people whose great scientific capacity had been coupled with the ability to be very prominent industrialists.

The Society did not draw a line, and no-one would wish it to, between grades of chemically trained people and others who had had the good fortune to live by and with chemical industry.

If there were one thing more than another which made for advance and happiness, it was the association of people of goodwill.

That was essentially true in business and industry, where great attention was given from time to time to methods of organisation. Many charts were drawn out with circles, squares, lines and brackets, and some people seemed to think the circles and squares need only contain the names of mediocrities to produce a good system. That was, of course, sheer nonsense, and unless an organisation were sufficiently elastic to allow for the differences in human beings, it was doomed to failure. On the other hand, almost any reasonable system would work with men of goodwill.

Seller's Market Demoralises

For quite a long time, continued Dr. Rogers, most of industry had been running at full capacity with regard to plant and labour. A salesman, in circumstances where demand outstripped supply, held the position of a lordly distributor of rations, and the purchaser was a little afraid to make complaint lest worse befall him; so that we were apt to find salesmen and technical service men becoming a little demoralised.

When difficulties arose, however, it was well to see what use could be made of them, while at the same time trying to get out of them. In such circumstances everyone became more acute in his job, with good results all round. We must make use of such times to make desirable alterations, so as to be in the best possible condition to take advantage of a rising market when it came. It was true, of course, that revenue and capital difficulties made it extremely troublesome to do those things; nevertheless, he urged that we should be optimistic and do the best we could. It had been said that the best time to spend money in industry was when we hadn't any; but he admitted the difficulty, especially in view of the attitude of such usually friendly people as bank managers.

Speaking of the need for securing better housing conditions for the Society, the President said that if there were agreement about the essentially industrial nature of its interests, surely chemical industry was big enough and sufficiently well off to see that its chief society was well established in suitable premises. He was well aware of the capital difficulties, of the desire to use labour and materials in the best manner and also of the views expressed some years ago regarding the concentration of societies in a large scheme. Frankly, however laudable those desires were—and he was in agreement with them—they did not today represent practical possibilities, nor could they do so for many years. The matter should be dealt with by the Society, in view of the very serious position. He had been asked to be chairman of a small body within the Society to set about reaching definite conclusions.

Present funds, however, were not large enough to meet the situation, so that the practical interest and assistance of chemical industries and any others who thought the Society had value must be sought. In his opinion, a long view must be taken; otherwise the position, difficult as it was, would become impossible. While he fully appreciated the high costs prevailing and the obvious need for general economy, there were things even in today's circumstances that should not be neglected. The present moment was not the time to pass around the hat or to argue the matter; but he would like to receive help in any manner thought suitable at the appropriate time.

Venturing a comment on the national and international political situation—though he was not a party politician and did not speak as one—he said it appeared to him that at hardly any time in peace had the well-being and happiness of our country been in such jeopardy. In his opinion the real situation was not yet understood by all our people, largely because of the human difficulty of appreciating anything for which there were no real precedents, and we hardly had those in the happenings in the world today.

Association and Goodwill

Much good would surely come if association and goodwill were by-words. Chemical industrialists knew the value of co-operation with the trade unions, who were just as anxious as the employers to preserve and advance the country and the happiness of its population. Was it not possible to have an association of the best political brains and experience in this country working together with goodwill to attain results of the kind we all wished? To his non-party mind the results of the last two elections seemed to indicate the wish of the country for something of the sort. Surely, if such men came together.

they could achieve much. He was not a pessimist, and he felt that more suitable steps could be taken to improve upon the present state of affairs. Our country and our industries were worth saving, and we had the experience and ability to do it if the powers we possessed were properly used.

Following the annual meeting the members and guests and their ladies were entertained to luncheon by the Aberdeen and North of Scotland Section, Mr. Beecroft again presiding. He offered all present a very warm welcome on behalf of the Section, and drew attention to the facilities which had been provided in Aberdeen for the comfort and convenience of all the visitors. He concluded with the Scottish expression of goodwill—'lang may your lum reek.'

Dr. Colgate (chairman of the Council) said the luncheons arranged by the Sections who were the hosts of the Society on the occasions of its annual meetings were always very enjoyable, but he suggested that the function on that occasion was just a little different, for the Aberdeen Section was relatively new; and the fact that the occasion was the first annual meeting of the Society to be held in Aberdeen added additional importance to that very friendly gathering.

The afternoon of Tuesday was devoted to works visits and social outings, and in the evening the visitors assembled in the Beach Ballroom at Aberdeen as the guests of the Lord Provost, Magistrates and Town Council of the City.

Messel Medal Presented

The principal function on Wednesday morning, 9 July, was the presentation, by the president, of the Messel Medal of the Socety to Sir Henry Tizard, G.C.B., A.F.C., D.Sc., F.R.S., who subsequently delivered an address under the title 'The Strategy of Science.' Sir Henry, who has received many honours, is perhaps best known for his services to the nation until recently in his capacity as Chairman of the Government's Scientific Advisory Policy Committee and of the Defence Research Policy Committee.

It was just as easy, Sir Henry said, to waste money on research as on anything else—especially if it were the taxpayers' money. In this connection he recalled a remark once made by the late Lord Rutherford concerning the advantage held by scientists—'We have not got any money, so we have got to think.'

He had a sense of perplexity and frustration when he considered the state of the country and the small probability that we should recover real economic stability in his lifetime, and he asked himself whether we had taken the wrong turning. In this year 1952, we found ourselves depending on charity from overseas to avoid bankruptcy. He spoke of difficulties concerning raw materials, high taxation and restrictions, which hampered enterprising adventure, and said he did not think the serious state of the country was sufficiently realised, certainly not by the average working man, who was more intelligent politically than the average working man of any other country. One could not blame the average working man for not being able to see the dangerous condition of the economic structure of the country when it was hidden behind a false façade of full employment and record output and profits and when no political leader told him the truth in plain language.

Not Temporary Bad Luck

Surveying the position, he said it was a great mistake to look at it as a piece of temporary bad luck and to base any strategy on the hopeful assumption that, if we held on by our teeth and discouraged industrial adventure by cutting down capital expenditure, a happy time would come without further enterprise on our part, when food and raw materials would again be cheap. The volume of exports now needed to pay for a given volume of imports was no higher than in the years from 1900 to 1914; indeed, it was rather lower.

There had been a general drift of the British economy from a state of stability before 1914 to the present state of instability. In the years from 1900 to 1914 we had a surplus of payments. After the first world war the terms of trade had fallen, raw materials and food became cheaper, which was a piece of very good fortune for us and misfortune for most of the rest of the world, including the British Dominions. It had helped us to get through a period of world-wide depression much more comfortably than any other country, and it went on for so long that some economists regarded it as normal. But even during that favourable period, when science and industrial re-

search had flourished, our balance of payments had gradually depreciated. Scientific men, he said, must not avoid looking at the position.

Sir Henry went on to emphasise that our present troubles were not to be attributed wholly to the war or to the bad judgment of successive Governments. They were fundamental. There was a longstanding weakness in the British economy, which had become more difficult to eradicate the greater the population had grown. There was the view that the ultimate solution of our economic difficulties was to be found only in a better distribution of population throughout the British Commonwealth. But even if that were an agreed policy, which it was not, it would take a long time to bring about. Meanwhile we must balance our trade as best we could by exporting what the world needed. As that obviously depended on the good judgment with which science was applied to industry, it was worth while asking ourselves why the great revival of science between the wars did not realise all our hopes.

Our Technology Weak

We in this country, he said, were worried about our weakness in technology, and the Americans were worried about their weakness in pure science and were taking vigorous steps to remedy it; he would do the same if he were in America. He did not like the insistence on what was called the importance of fundamental research, but felt that it had become a cliché which we should avoid. He did not think the scientific prestige of the nation or the quality of scientific education would suffer if we took a more objective view of industrial research, which we must if we were to regain economic stability. If we tried to spread our efforts over too wide a field we should fail to do the things that mattered either well enough or in time; the things that mattered were those which would help to restore the balance of overseas trade, directly or indirectly, as quickly as possible. Until we had a favourable balance of trade for at least five years in succession we could not afford to spend more on developments which, however interesting in a perfect world, were not fundamental to our existence.

Confessing that he was puzzled by some features of the chemical industry, puzzled by its relative lack of influence on the world's export trade—and he gave figures in this connection—he said the discoveries of British chemists still seemed to attract more attention in countries abroad than in our own. One explanation given to him was that we could not possibly afford the very large expenditure on chemical research and development which was incurred by the American firms. But, he said, God was not always for the big battalions in research. In defence research and development we did not spend one-fifth of what was spent in America, but we held our own and often led the way.

He did not like to think that British industry was becoming less adventurous. But so long as financial restrictions remained, so long as industry as a whole was handicapped in capital expenditure, which it was, it was quite idle to blame scientists because their discoveries were exploited elsewhere.

It was more important to strengthen our technology than to expand our science. We must avoid the luxury of employing first-class scientists on second-class projects. Science was not enough; and he again quoted Lord Rutherford's words, 'We have not got any money, so we have got to think.'

The President and Mrs. Rogers received and welcomed many distinguished guests on the occasion of the Society's annual dinner, which was held in the spacious Elphinstone Hall of King's College, Aberdeen, on Wednesday evening, 9 July. The principal guest was Mr. James Dillon, T.D., formerly Eire Minister for Agriculture; he had much for which to thank the Society in regard to its work in agriculture and in the incomparable cause of informing the world of the benefits which science conferred. The guests also included Dr. T. M. Taylor (Principal and Vice-Chancellor, University of Aberdeen), Baillie F. Magee (of Aberdeen), Sir Henry Tizard (Messel Medallist), Professor A. Haddow (Lister Memorial Lecturer), Professor Niels Bohr (of Denmark) and Monsieur E. J. Solvay (of Belgium).

Niels Bohr Honoured

A pleasing ceremony which was performed after dinner by the President was the conferment of Honorary membership upon Professor Niels Bohr and Monsieur Ernest Solvay.

A token investiture of Mr. Francis J. Curtis, incoming president, was also made by Dr. Rogers.

Professor Alexander Haddow, M.D., D.Sc., Ph.D., the Director of the Chester Beatty Research Institute at the Royal Cancer Hospital, London, delivered the Lister Memorial Lecture on Thursday morning, 10 July, his subject being 'The Place of Chemistry in the Study of Cancer.'

Lister himself, he said, had always shown great interest in the relationship of chemistry to medicine. He had graduated in medicine from London University 100 years ago; we saluted him for the dignity of his life and the solace and the balm which it had brought to the whole of humanity.

The conquest of infection, progressing steadily from Lister's time to the present day, had been a potent factor in the extension of human life. Whereas only a few generations ago the minority of citizens attained the age of 60 years, the great majority now surpassed it. The solution of one problem had raised others no less compelling, and it was the increased expectation of life arising partly from the conquest of infection which had in part brought cancer to the forefront as one of the main causes of human mortality.

The burden of Professor Haddow's address was that in the solution of the problem a vital share had been and was being taken by chemistry. One was entitled to stress the great good which had come from chemistry, and the greater good still to come, especially through its union with modern biology and medicine. Apart from its medical and humanitarian aspect, cancer was also an intellectual challenge, and it would perhaps be man's greatest triumph when he could order and control the growth of the cells from which his frame and that of every other living creature was made. In all those approaches, medical and fundamental chemistry was destined to play a major and almost certainly a decisive rôle.

Recent Advances

There had been considerable advances in recent years, he said, in our knowledge of the mechanism of cancer production and causation by chemical means. Of late the evidence had pointed very strongly to the cancer cell being produced by a process of enzyme modification or loss. That had the utmost theoretical significance, and he referred to evidence indicating the eventual possibility of controlling the process by a kind of enzyme substitution.

Meantime, in the course of such work, and independently, progress was being made in the chemotherapy of cancer more immediately established as a consequence of the 'cross-linkage' hypothesis and with special reference to the aromatic nitrogen mustards, polyethylenimines and dimethanesulphonoxyalkanes. One of the last had proved to be the most useful chemical agent so far in the practical treatment of chronic myeloid leukaemia. Again, very recent work had indicated that the prospect of enhancing the usefulness of such substances was perhaps greater than we had thought even a year ago, and certainly we now had agents very much more intense in their growth-inhibiting action than ever before.

Edinburgh and Lister

Mr. F. J. Bolton, the Chairman of the Edinburgh Section of the Society, welcomed the opportunity to thank Professor Haddow, for Edinburgh had rather particular ties with him and with the Lister Memorial Lecture. At the time the Lister Memorial Lecture was founded, the Aberdeen area was included in the Edinburgh and East of Scotland Section of the Society; since that date the Aberdeen and North of Scotland Section had been founded; and it was extremely pleasing that the Lister Memorial Lecture had now been delivered in Aberdeen. Professor Haddow, also a Scotsman, was a product of the Edinburgh Medical School.

It had been known for some time that the cancer problem would be solved only by the collaboration of the medical man with the biologist, the bio-chemist, the organic chemist and the physicist, and it was of great interest to hear Professor Haddow's interesting examples of what the industrial chemist could contribute. Mr. Bolton wished him success in his efforts and added that, from what he had said, we might look forward to hearing very great news in the future.

On Thursday evening the University of Aberdeen offered hospitality to the Society. Dr. T. M. Taylor (the Principal and Vice-Chancellor) and Mrs. Taylor received the guests at Marischal College. The Mitchell Hall of the College provided the ideal setting for such a function.

Lignosol Chemical Plant Opened

Balanced Research, Sales & Production

THE recent official opening of the $1,250,000 plant of Lignosol Chemicals, Ltd., by Quebec's Prime Minister, Maurice L. Duplessis, in Quebec City, brought to a climax a decade of patient research and steady development.

Lignosol comes from spent sulphite liquor, the by-product of chemical wood pulp, and it comes in liquid and in powder forms. It is used in road building as a soil stabiliser, in the manufacture of leather, as a dye levelling agent, as a cement dispersant, an adhesive for gummed tapes, a ceramic plasticiser, a foundry core binder, a refractory binder, and as an additive in electrolytic copper refining.

Two Years Old

Lignosol Chemicals, Ltd., was incorporated two years ago with a capital of $5,000,000 supplied jointly by the Anglo-Newfoundland Development Company, of Grand Falls, Newfoundland, and the Anglo-Canadian Pulp and Paper Mills, Ltd., of Quebec City.

The productive capacity of its plant is 22,500 tons per annum, of which some 40 per cent is exported to the U.S.A. Close to 100 per cent of the plant's raw materials come from the province of Quebec. Sales for 1951, which was the first production year, totalled $230,000, while they are estimated at $400,000 for this year, and at $750,000 for 1953.

F. T. Atkinson, M.C., of Quebec City, is president and general manager of Lignosol, while the chairman is Dr. E. M. Little, also of Quebec City, president and general manager of Anglo-Canadian Pulp and Paper Mills, Ltd.

Lignosol itself is a derivative of lignin. In the acid sulphite process, chipped wood is cooked in a chemical solution. This dissolves out the lignin, wood sugars, and other soluble substances which form about half the dry weight of the wood, leaving sulphite pulp. The resultant spent sulphite liquor is the source of the lignin.

The idea of making use of this ready supply of lignin is not new. In the past, several methods of extraction have been introduced and are being used with varying degrees of success. It was felt that more efficient extraction methods could be devised and that many new industrial applications could be evolved. This is indeed proving to be the case.

The recovery of lignin from spent sulphite liquor would probably be universal, were it not for two major problems. Firstly, this liquor contains a large proportion of water which must be removed economically. Secondly, it contains calcium sulphate, which forms a scale on heat exchange surfaces during concentration, and soon prevents the necessary heat transfer.

It was these difficulties which greatly curtailed recovery of lignin in the past. In addition, many industrial applications call for special modifications of the original product. Solution of these basic problems was essential to the life of Lignosol.

In 1943, at Chandler, a town on the coast of the Bay of Chaleur in Quesbec, a pilot plant was first built for the production of Lignosol. The plant consisted of open wooden tanks in which the spent liquor was boiled until it reached a concentration of 50 per cent by weight. It was then ready for sale, but in liquid form only. Additions and modifications were later made to this process, and the Chandler pilot plant came to form the nucleus for Lignosol development during the next nine years.

Highway Stabilisation

Lignosol was first used by the Quebec Roads Department for highway stabilisation around the Gaspe Peninsula. Its value was soon evident, and the technique of application improved with practice. Today, over six hundred miles of highway have been treated. At the same time other uses were being established and proved. In addition to use as a binding and stabilising agent for gravel roads and air strips, prior to paving, Lignosol was finding markets in various other fields.

Many of the best markets called for modified products, and in 1944 the first new type of Lignosol was produced. This was Lignosol T, known to the tanning industry as 'spruce extract', and used in the tanning of leather.

At this stage, the need for a good balance between research, production and sales was also becoming an important factor. While much had been accomplished without a sales force specifically assigned to Lignosol, its absence now became more keenly felt as research indicated new potentials for the products. Accordingly, a Lignosol sales staff was appointed.

The results were gratifying: the market for older applications was widened: customers' suggestions for improvements and applications began to flow in more quickly; other information from the field stimulated new lines of development. The sales force has continued to prove as valuable in bringing in information as in disseminating it to potential customers.

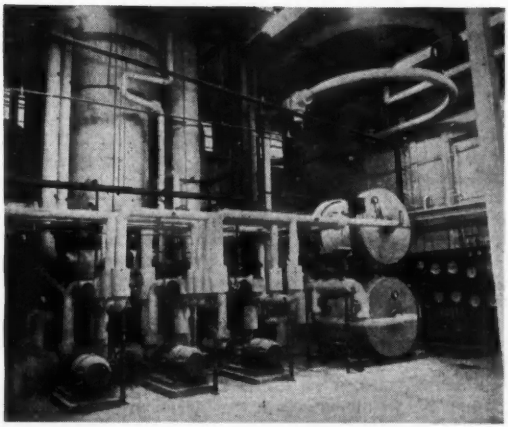
One immediate outcome of this added source of information was emphasis on the need for a powdered product. A spray dryer was installed for the production of powdered Lignosol, and new markets were opened up where it had previously been impractical to ship liquids. Lignosol SF, used in the manufacture of Portland cement, and in a cement plasticising and dispersing product, was the first of the new series of modified products to result from this impetus.

Demand for this material grew very rapidly, and it became one of the most important forms of Lignosol. Two new types of Lignosol T were also developed, and were well received by the tanning industry. An adhesive for gummed tape followed. New core binders, ceramic plasticisers, grinding aids, products for pelleting, and dispersants are some of the most recent developments. The search for new products goes on, and more and more industrial problems are finding their solution in Lignosol.

Meanwhile, studies were going forward on the development of new production equipment that would reduce evaporation costs, eliminate the scaling problem, and widen the range of Lignosol products. Most notable result was the thermal compression evaporator. A pilot plant was first built at Chandler, and its operation studies and design altered until it was finally modified to meet the requirements for efficient concentration of the spent sulphite liquor.

Adaptation of this evaporator and the virtual elimination of the scaling problem were noteworthy achievements. A paper given on this subject by members of the Lignosol technical staff, at the 1950 meeting of the Technical Section of the Canadian Pulp and Paper Association, won for the authors the Weldon Medal, awarded annually for the best research of the preceding year.

The Chandler pilot plant had been expanded to keep pace with sales until it finally became a production unit. However, by 1948 the existing facilities were obviously inadequate to meet growing customer requirements. The original plant had served its purpose of establishing markets and uses for Lignosol, and the time had come to rebuild and reorganise. Design was begun for a completely new plant in Quebec City.



The heart of the Lignosol plant is this room containing the evaporator in the background, the panel board and the heat exchangers (right foreground), the feed and distillate pumps, at left. Total height: approximately 40 feet

Construction started in 1951, and early the following year all equipment had been delivered and installed. The official opening of the plant was held last June.

The new Quebec plant, which also houses the company offices, turns to practical advantage the findings of the earlier development studies. From the new Thermal Compression Evaporator to the streamlined packaging and shipping facilities, every possible improvement has been incorporated for the most efficient production of Lignosol. Excellent laboratories support a continuous programme of research, development, and testing. Their staff is always available to help investigate new applications of the product, and to assist those seeking special modifications to meet specific requirements.

All Lignosol powders are light tan to brown in colour. They form dark brown solutions. All are freely soluble in water. Where both liquid and powdered grades are available, the suffix D is used to distinguish the latter.

Lignosol B and BD	Calcium lignosulphonate	Soil stabilisation; refractory binder; foundry core binder; ceramic plasticiser; adhesive.
Lignosol T	Lignosulphonic acid	Manufacture of leather.
Lignosol N and ND	Magnesium lignosulphonate	Manufacture of leather. Dye levelling agent.
Lignosol SF	Sugar-free calcium lignosulphonate	Cement dispersant.
Lignosol A	Formulated lignosulphonate	Adhesive for gummed tape.
	DEVELOPMENT PRODUCTS	
Lignosol TS	Ammonium lignosulphonate	Manufacture of leather; dispersant.
Lignosol X	Sodium lignosulphonate	Dispersant; ceramic plasticizer.
Lignosol SFX	Sugar-free sodium lignosulphonate	Dispersant; additive in electrolytic copper refining.

Liquid products are shipped in tank cars or packed in 500 lb. drums. Powdered products are packed in 5-ply moisture-proof Kraft bags, weighing 75 lb. each. A minimum carload is 50,000 lb. in Canada, 40,000 lb. in the United States.

New ideas and developments are still adding further chapters to the story of Lignosol. But an industry such as this does not only grow. It also evolves. New ideas may change direction many times before they find their final shape. What may start out as an idea for the improvement of a tanning product, may end up instead as a cement dispersant. A cement dispersant may be adapted to the manufacture of a grinding aid. Furthermore, each idea must compete with a profusion of others seeking the same end. Each must survive on its own merits. Those that do survive are the healthy results of free competition. And although these ideas may develop slowly, and in a diverse fashion, they develop into sound products.

Fear of Synthetic Petrol

Washington *versus* Industry

A FIERCE battle between the U.S. Government and the U.S. oil industry over the question of developing oil from coal processes may be won in July when the National Petroleum Council meets.

The battle began when the U.S. Bureau of Mines, after years of costly research and experiment, claimed that it could produce petrol from coal at 11 cents (about 9d.) a gallon at the refinery—about the same price as petrol refined from crude oil. They spent $20,000 dollars (£7,150) to have an engineering firm prove its claim.

The oil industry, fearing that a source of cheap synthetic petrol which some day would cut deeply into its profits had been tapped by the Government, hit back. It produced a galaxy of notable research men and gave them the job of carrying out the most exhaustive and costly survey on the subject. The result of this survey was the industry's claim that, discounting the sale of by-products, it would cost 41 cents, not 11, per gallon to produce the petrol. The sale of by-products, says the industry, has no true part in the picture at all. In short, it claims that the Government's findings are the result of miscalculated financing. Now the Government has produced yet another independent survey which supports some contentions and refutes others.

Mr. L. C. Kemp, in charge of research for the oil companies, has said that the idea was most unlikely to succeed in competing with the crude oil refineries. He has built up a mass of facts and figures which the industry regards as so indisputable that it is willing to stand or fall by them. Apart from that, the industry points out that the Government cannot easily find the $411,000,000 it would need to start the oil-from-coal plan on a commercial basis. The oil industry's comments are not likely to make this task any easier.—B.U.P.

A Compact Unit for Semi-Microanalysis

by J. T. STOCK, M.Sc., Ph.D., F.R.I.C., & M. A. FILL, F.R.I.C.

SOME four years ago, the Chemistry Section of Norwood Technical College, London, changed over completely from micro to semi-micro inorganic qualitative analysis. (*See* J. T. Stock, and M. A. Fill, THE CHEMICAL AGE, 1952, **66**, 537). Since that time, development work in this field has been pursued with three main aims in view. These are (i) the further simplification of technique, (ii) the extension of the basic scheme to include the less common elements and (iii) the design of apparatus. Under the latter heading has emerged a block-type unit incorporating most of the equipment needed for small-scale analysis. This unit has proved to be both useful and convenient, its compactness being noticeable both in storage and in use.

The block is of hardwood and has the approximate dimensions 9¼ in. long by 2½ in. wide by 1¾ in. high. It is drilled and recessed as shown in Fig. 1 to accommodate the following (the lettering indicates the location of the various parts in the block):

A and A′—8 heavy-quality hard gloss micro test tubes, 75 mm. by 10 mm. diameter (for working).

B—1 ditto (for counterbalance in centrifuging).

C—1 ditto (as container for platinum wire holder).

D—1 ditto (as container for glass rods, capillary tubes, etc.).

E—1 double-ended container for litmus papers.

F—1 4-oz. wide-mouthed screw-cap bottle.

G—1 hydrogen sulphide attachment.

H—1 glass shovel-type spatula.

I—1 combined drop-testing device and test paper holder.

J—1 pair tweezers.

K—2 microscope slides.

L—1 strip cobalt glass (3 in. by 1 in.).

M*—1 glass frame support for slides.

N—1 crucible, 10 ml.

O—1 crucible lid.

P and Q—1 crucible holder.

R‡—1 test pipette.

S‡—1 stoppered specimen tube, 40 mm. by 18 mm. diameter, for filter paper strips.

The withdrawal of test tubes from the rear row is facilitated by making their containing holes (marked A′ in Fig. 1) shallower than the holes for the front row.

Failure to counterbalance a tube during centrifuging not only introduces an element of danger but also places unwarranted strain on the bearings of the centrifuge. A test tube identical with the others actually used for working is therefore kept specially for counterpoising and is filled with water to approximately the same height as that in the tube containing the sample to be centrifuged.

The platinum wire holder forming the cap to the tube retained in hole C is constructed

* A rectangle 70 mm. × 60 mm., made from 4 mm. diameter glass rod.

‡ Holes for these items are drilled in one end of the block.

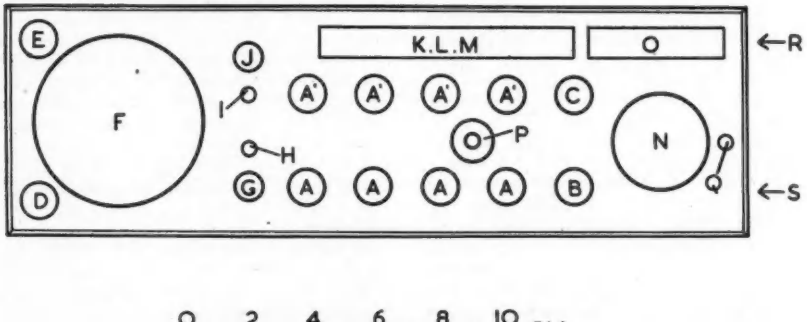


Fig. 1—Details of block

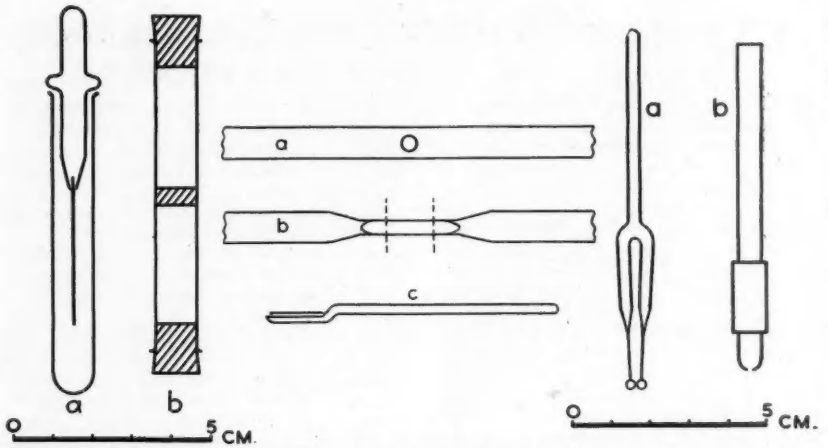


Fig. 2—(a) Platinum wire holder; (b) container for test papers. Fig. 3—Stages in the construction of glass spatula. Fig. 4—(a) Drop-testing device and test paper holder; (b) hydrogen sulphide attachment

by forming a flange on a short length of 6-mm. diameter glass rod, as shown at (a) in Fig. 2. A section of cork forms the partition in the double-ended container shown at (b). One end contains red, the other blue litmus paper strips.

Stages in the construction of the shovel-type spatula (*see* also J. T. Stock, and M. A. Fill, *Analyst*, 1947, **72**, 394) are shown in Fig. 3. A hole about 4 mm. in diameter is blown in one wall of a length of 10-mm. outside diameter glass tubing, as at (a). After heating in the region of the hole, the ends of the tubing are pulled apart, as shown at (b). When cold, a 15-mm. length of the central portion, which has the cross-section of a shallow U, is cut out. One end is fused to the slightly-cranked end of a 70-mm. length of 3-mm. diameter glass rod and the other end is fire-polished, giving the finished spatula (c).

The device having the dual uses of drop testing and of holding test papers is shown at (a) in Fig. 4. In constructing, the ends of a short length of 3-mm. diameter glass rod are drawn down to threads about 1 mm. in diameter. By careful fusion, balls about 2 mm. in diameter are formed on the ends of the threads. Bending hairpinwise at the mid-point and addition of a handle completes the device. Test papers are gripped by slipping between the balls. (This is, of course, done before wetting the paper). When used for testing gases with drops of aqueous reagents (as opposed to tests performed with the aid of test papers), the drop of reagent picked up by dipping the device into the reagent is of uniform size and of greater stability than a drop picked up on the end of an ordinary glass rod. When necessary, a device of this kind may also be used for delivering measured and reproducible quantities of reagents to a microscope slide or similar surface (J. T. Stock and M. A. Fill, *Metallurgia*, 1946, **34**, 107).

Because of the favourable surface-to-volume ratio encountered in micro and semi-micro analysis, saturation of a solution with hydrogen sulphide may be simply and rapidly accomplished by agitating the solution in an atmosphere of the gas. High-pressure generators, needed with the capillary delivery tubes used in the alternative 'bubbling' method, may then be dispensed with, hydrogen sulphide being drawn from an ordinary Kipp generator. The delivery attachment (Fig. 4b) used in the operation is a 70-mm. length of 5-mm. outside diameter glass tubing, the bore at one end having been reduced to 1 mm. diameter. A short piece of rubber tubing slipped on to the constricted end enables the attachment to fit snugly into the mouth of the micro test tube containing the solution to be treated

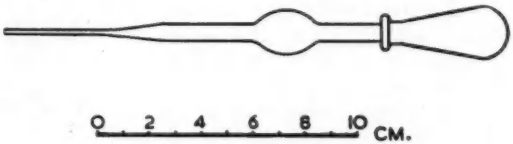


Fig. 6—Teat pipette

(J. T. Stock and P. Heath, *Metallurgia*, 1950, **42**, 44).

After connecting to the generator the attachment is placed loosely in the mouth of the test tube. The generator stopcock is then partly opened and 10 to 15 bubbles are allowed to pass through the gas-washing bottle, thus displacing most of the air from the test tube. The attachment is then firmly thrust home and, with the stopcock open, the test tube is agitated for about a minute (e.g. by lightly flicking the bottom with the finger), avoiding splashing as much as possible. Having stopped the gas supply, the test tube is detached, the contents centrifuged and the treatment with hydrogen sulphide repeated to check the completeness of precipitation. Thorough rinsing is normally ample for removing the small amount of contamination of the attachment occurring during ordinary use. Deposits may often be removed by boiling-out in dilute nitric acid; in cases of bad contamination, however, renewal is simpler and quicker than such treatment.

Evaporation is carried out in an ordinary porcelain crucible supported in a holder of ¼ in. diameter steel wire (nickel or stainless steel are of course preferable materials). The shaft of the holder (Fig. 5(a)) carries a short length of snugly-fitting rubber pressure tubing. The position of the latter controls the depth to which the shaft enters the tubular brass sleeve let into the top of the block (Fig. 5(b)). Adjustment of the distance of the crucible above the source of heat may then be readily accomplished. An ordinary Bunsen burner with the flame tube removed and ignited at the jet is a satisfactory source of heat if the flame height is adjusted to about 15 mm. When not in use, the crucible and its holder pack away as shown in broken lines, Fig. 5(b).

It is a basic principle of the technique to clean the teat pipette (Fig. 6) *immediately* after each usage. Hence, although finding almost continuous employment throughout the analysis, a single teat pipette is adequate in nearly all cases. When the block is out of use, the pipette fits into a deep horizontal hole in one end of the block. Otherwise, the pipette is stood jet-downwards in distilled water contained in the 4-oz. wide-mouthed bottle provided at one end of the block. The procedure adopted is then (i) the pipette is picked up and the water within it is ejected into the sink, (ii) the solution to be handled is then taken up and delivered, emptying the pipette as completely as possible, (iii) the pipette is about half-filled with water from the bottle and then emptied into the sink, (iv) operation (iii) is repeated, the pipette then being returned to the bottle with the teat compressed. The latter is then released so that water is drawn into the pipette. At intervals, the contents of the bottle are thrown away and replaced by fresh distilled water. These simple precautions minimise the risk of failure of an analysis through accidental contamination.

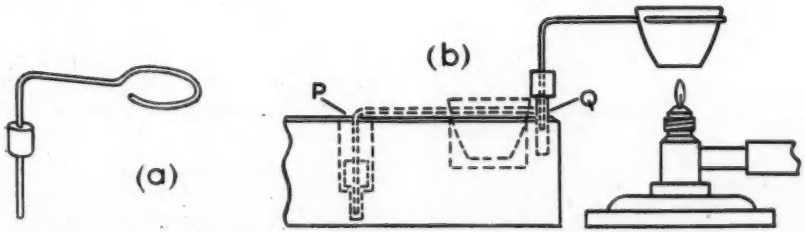


Fig. 5—Holder for crucible (stowed position shown in broken lines)

Wood Impregnation

New U.S.A. Process Recovers Solvent

A NEW process for wood treatment has been developed which should prove valuable for products which must be treated with oil-borne preservatives before being painted. The new process is the result of tests conducted by the Taylor-Colquitt Co., Spartenburg, South Carolina, in co-operation with Darworth Inc., Simsbury, Connecticut, suppliers of Cuprinol copper-naphthenate, and E. I. Du Pont de Nemours & Co., Wilmington, Delaware, who supplied the chlorinated solvents used.

The tests were aimed towards the recovery of solvents from wood pressure-treated with oil-borne preservatives. The method developed not only recovers the solvent but also yields a satisfactorily paintable wood, even when freshly impregnated.

Six Solvents Used

The impregnating agent, copper naphthenate, was dissolved in six different solvents, but no significant differences appeared in any of the six solvents used. Almost complete recovery was obtained from the copper-naphthenate-treated wood by using a modification of the well-known 'vapour drying' process. The processed wood was found to be entirely free of undesirable deposits and in better condition than untreated pine wood as far as paintability was concerned. Not only were the sticky surface deposits of copper naphthenate removed but also the natural pine resins. Comparative paintability tests were made on matched charges of boards, pressure-treated with copper naphthenate in a given solvent. On the solvent-recovery processed boards there was marked improvement as to the degree of discoloration of those painted.

In the test, two matched loads of kiln-dried pine boards were used. One load was pressure-impregnated with the copper naphthenate solution, and was then replaced in the treating cylinder by the second load, which was also pressure-impregnated. After the preservative treatment the second charge was exposed to the action of the solvent vapour in the treating cylinder. One-hour vapour treatment was followed by a one-hour vacuum treatment. The procedure was repeated and after the second vacuum treatment the load was steam-reconditioned for a short period, and removed from the cylinder. The recovered preservative, in solution, is concentrated in the evaporator of the vapour-recovery plant to which it is carried. When the concentration reaches the proper level (about 9.4 per cent) the solution goes to the treating tank for re-use. The solvent recovery process was found to save 470 to 980 lb. of solvent and 20 to 25 lb. of copper naphthenate per 1,000 FBM.

Big Australian Contract

A CONTRACT has been received by Simon-Carves (Australia), Pty., Ltd., an associated company of Simon-Carves, Ltd., of Stockport, to build a large Simon-Carves Monsanto Contact Sulphuric Acid Plant at Port Adelaide to produce sulphuric acid from pyrites, of which abundant local deposits exist. The primary purpose is to provide sulphuric acid for the production of large quantities of superphosphate fertilisers for South Australia. The plant will be operated by a new Adelaide company, Sulphuric Acid, Ltd., on behalf of three superphosphate companies, namely Cresco Fertilisers, Ltd. (by whom the contract was placed), the Adelaide Chemical & Fertiliser Co., Ltd., and Walleroo-Mount Lyell, Ltd. It will be possible to duplicate the plant, thus ensuring ample acid supplies for a future increased demand for superphosphate or for any type of chemical manufacture which may be started in Adelaide.

The plant will incorporate three Nichols Freeman flash roasters to produce sulphur dioxide gas from pyrites, and the gas will be treated in gas cleaning and cooling units. The acid-making plant will be a single unit with a capacity of 300 tons of sulphuric acid per day, and will be the largest single-unit sulphuric acid plant in the British Commonwealth.

The eventual value of the contract is expected to be about £A2,000,000. It will be carried out by Simon-Carves (Australia) Pty., Ltd., manufacture being undertaken partly in Britain and partly in Australia. Construction is to begin at once, and the plant will be in production in two and a half years.

Change of Address

The Institute of Metal Finishing has moved its offices to 32 Great Ormond Street, Holborn, London, W.C.1. Telephone No. Chancery 6793.

A Review of Phenol Analysis

Part IIIa—Quantitative : General (i)

THE importance of phenol analysis to industry was stressed in the first two parts* of this review. As with the qualitative analysis, a considerable literature exists concerning the quantitative analysis of phenols in many materials, most of which are either products of industry or are used extensively in industrial processes. This review deals mainly with the developments in methods for the determination of phenols which have been proposed during the past thirty or so years. It is assumed that the reader is aware of the classical methods of phenol analysis, as these will be mentioned by name on several occasions in subsequent pages. Many of these classical methods are in use today with little or no modification to the original procedures, so it is not intended to detail these. For purposes of convenience, the methods for the determination of phenols can be broadly classified as follows:—

(a) General Methods.
(b) Determination in Biological Materials.
(c) Determination in Tars and Allied Products.
(d) Miscellaneous Methods (including pharmaceuticals, disinfectants, developers, soaps, essential oils, waters, air).

A—GENERAL METHODS

(1) *Colorimetric Methods*: Several diazometric procedures have been proposed for the determination of phenol and certain of its homologues. Chapin[1] used such a method to determine the strength of cresylic acid solutions containing the lower monohydric phenols of the benzene series. 0.1N *p*-nitroaniline solution is permanent in the dark, and Chapin prepared a 0.05N diazo solution by adding an equal volume of 0.1N sodium nitrite solution. 20 ml. of the unknown solution was then treated with 50 ml. of 10 per cent sodium acetate solution and the mixture neutralised with acetic acid. 10 ml. of 30 per cent basic lead acetate solution was added as hydrion buffer, followed by 10 ml. of freshly prepared diazo solution. The end-point is determined by porcelain plate spot tests after filtration of very small portions.

Hilpert and Gille[2] preferred the *p*-nitroaniline method to the sulphanilic acid procedure for the colorimetric determination of phenols in strongly alkaline aqueous solutions. They used as standard solution an azo dye prepared from thymol and *p*-nitroaniline. Good results were obtained with solutions containing phenol, *o*-, *m*- and *p*-cresol, resorcinol and α- and β-naphthol.

Bielenberg and Goldhahn[3] prepared the azo dyes of catechol, resorcinol and phloroglucinol by coupling with *p*-nitroaniline, diazonium chloride. When solutions of these in benzene or *iso*amyl alcohol were mixed and passed down an alumina column, a clear-cut separation was obtained.

Less Accurate Method

Although some workers claim that the diazo sulphanilic acid method is less accurate than procedures using *p*-nitroaniline, Hanke and Koessler[4] obtained excellent results with the former reagent on quantities of phenol, *p*-cresol, *p*-hydroxyphenylacetic acid, tyrosine and tyramine as small as 5μg. The colour obtained is intensified and stabilised by the addition of sodium hydroxide and hydroxylamine hydrochloride. In a later paper[5] these workers extended the use of this reagent to the determination of other phenols including *o*- and *m*-cresol. They stated that phenol and *o*- and *m*-cresols coupled with great speed, and gave rise to yellow colours. When compared with standards prepared from indicators, results accurate to 0.5-3 per cent were obtained on 1-50 μg. of sample.

The classical Gibbs method for the colorimetric determination of phenols has recently been critically examined by Ettinger and Ruchhoft[6], who investigated various factors which affected the intensity and characteristics of the colour produced in the reaction of the 2,6-dibromoquinone chloroimide reagent with various phenols. They applied their findings to the determination of phenol and the 3 cresols in aerobic surface waters.

An earlier paper by Baylis[7] had described several applications of this reagent, which is sensitive to 1 part of phenol in 10^6. An addendum to this paper describes the author's procedure for concentrating phenols

* THE CHEMICAL AGE, 66, 301-304, 333-336.

for the determination of very small quantities.

Levy[8] modified the earlier method of Houghton and Pelly for the determination of phenols in very dilute solutions, using 2,6-dibromo-4-aminophenol as reagent. The *p*H of the phenol solution was adjusted to 9.2-10.5, the reagent added, and after mixing, 2 ml. of 0.05 per cent sodium hypochlorite solution were added for every ml. of reagent. The indophenol colour developed in 3-5 minutes. It was also found that an aqueous or alcoholic solution of the chlorostannate of 2,6-dibromo-4-aminophenol, on addition to the buffered solution, produces a coloured solution which lends itself perfectly to the determination of phenols in such solutions.

Phenols are easily nitrosated to give yellow nitrosophenols and several colorimetric methods for the determination of phenols are based on this reaction. Thus, Stoughton[9] applied the reaction to the determination of phenols in biological materials.

Luchinskii's Method

A little-known but valuable method for the colorimetric determination of phenol is due to Luchinskii[10]. It is based on the following reaction, which gives an intensely red product and which is sensitive to very small amounts of phenol.

$$C_6H_5OH + TiCl_4 \rightarrow C_6H_5OTiCl_3 + HCl$$

The main disadvantage of the method is its non-specificity, several phenols giving a similar reaction.

Hydroquinone is used extensively as an inhibitor in polymerisation reactions, and it is often of importance in determining the amounts present (1-200 μg.) at various stages of the reaction. Belcher and Stephen[11] successfully developed a colorimetric procedure for the determination of small amounts of hydroquinone in the presence of methacrylic acid. Excess of a ferric salt is added to the solution containing hydroquinone. The ferric salt is reduced with the production of an amount of ferrous iron equivalent to the amount of hydroquinone originally present. *o*-Phenanthroline is added, and the amount of ferrous iron is determined colorimetrically after suppressing the colour due to the excess ferric iron by addition of fluoride. More recently, Belcher and West[12] extended the method to the determination of as little as 0.1 μg. of hydroquinone.

Whettem[13] recently described a method for the determination of small amounts of hydroquinone (> 1 μg.) based on the formation of molybdenum blue by reduction of a solution containing phosphotungstate.

The Millon method is perhaps the best known classical procedure for the detection of phenols, and several workers have developed colorimetric methods based on the reaction. Chapin[14], for example, determined phenol itself in the presence of certain other phenols, making use of the high selectivity of the Millon reagent, which does not give colours with many mono- and polyhydric phenols. The author developed several variations in his final method, the choice of method depending on the phenol strength, the time available and the chemical nature of the commercial sample. A minimum of 0.04 mg. of phenol could be determined in the presence of 4 mg. of cresol in a volume of 4 ml., and the method gave satisfactory results when applied to the analysis of various commercial products. Pevtsov[15] used the Millon reagent to determine phenol in cyclohexanol. His method was briefly as follows:—Dissolve 1 ml. of the cyclohexanol solution in 100 ml. of water, add 1 ml. of Millon reagent and 6 drops of concentrated nitric acid, mix, and keep for 10-15 minutes on a boiling water-bath until the pink coloration is distinct. At the same time, keep for the same period on the bath, a series of solutions, which contains in the same volume of water a definite amount of phenol and which has been treated with the same amounts of Millon reagent and nitric acid. Compare the coloration 15 minutes after the solutions have been removed from the water-bath.

(2) *Titrimetric Methods.* Bromometric procedures are the most extensively used for the titrimetric determination of phenols, and many reliable methods are available.

Investigation of Cresol

Fox and Barker[16] investigated the analysis and composition of cresol. They found the classical method of Raschig to be reliable for the assay of *m*-cresol with but slight modification, and also proposed an alternative method depending on bromination of *m*-cresol in a dry solvent (carbon tetrachloride). After standing for several hours, the bromine and solvent are distilled off and the increase in weight of the sample determined. The method is available for mixtures of the 3 cresols using the equation:—

$$\% \ m\text{-cresol} = (100W - 246.3)\ 0.731$$

where W is the weight of the brominated derivative obtained from 1 g. of cresol.

The authors also adopted the earlier method of Ditz and Cedivoda for the determination of *m*-cresol in cresol. The modified procedure entailed dissolving 1 g. of the cresol in 5 ml. of 2N sodium hydroxide and diluting to 200 ml. with distilled water. 10 ml. of this solution are treated with 100 ml. of a mixture of equal parts of 0.05N potassium bromide and 0.01N potassium bromate, and 10 ml. of concentrated hydrochloric acid are added. After shaking for 1 minute, 20 ml. of 10 per cent potassium iodide solution are added, and the solution titrated after 1 hour. Addition of carbon tetrachloride sharpens the end-point. If X is the percentage of *m*-cresol, Y the bromine actually absorbed, then:—

$$X = (100Y - 308)\ 1.364.$$

The percentage of *o*-cresol may be obtained from the equation:—

$$0.0386\ P + (0.0128 \times O) = (G - 1.0388)\ 100,$$

where P is the percentage of phenol, G the density and O the unknown, i.e., the percentage of *o*-cresol.

All three cresols are susceptible of bromometric determination, though possessing different bromination periods. Danckworth and Siebler[17] showed that for *m*-cresol, 15 minutes is sufficient irrespective of the quantity, while *o*- and *p*-cresol require up to 72 hours. The authors claim that mixtures of the three cresols present no difficulties in the way of titrimetric determination, and report that the evaluation may be extended to various cresol preparations like lysol, Liquor Cresoli Saponatus, creolin and other related products, in which latter case it is only necessary first to eliminate the so-called neutral oils. A useful paper by Jarvinen[18] points out the difficulties that are likely to arise in the bromometric determination of phenols and cresols in crude cresol.

Bromometric Procedure

Scherbachev[19] determined phenol in commercial salicylic acid by a bromometric procedure. 10 g. of salicylic acid were dissolved in 100 ml. of N sodium hydroxide and carbon dioxide was introduced until the solution was colourless to phenolphthalein. The solution was then steam-distilled, and 500 ml. of the distillate treated with an excess of standard bromide-bromate solution and acid, the excess being determined iodometrically after 20-30 minutes. Phenol has also been satisfactorily determined by bromination in presence of excess arsenious acid and the latter titrated with bromine using fuschin as indicator.[20]

The following method was devised by Hart[21] for the bromometric determination of thymol in presence of interfering substances, e.g., in antiseptic solutions:—to 50 ml. of liquid sample contained in a platinum dish, add 5 ml. of 25 per cent sodium hydroxide, evaporate any alcohol present on a steam bath, transfer to a separating funnel, dilute to 75 ml., and extract with petroleum ether to remove any essential oils. Wash the latter with 10 ml. of 5 per cent sodium hydroxide, and extract the combined aqueous solution and washings with several lots of ether. Add 10 ml. of 0.5N potassium hydroxide to the combined ether extracts, evaporate at gentle heat, dilute to 25 ml., add 20 ml. of hot 5N hydrochloric acid and titrate immediately with 0.1N bromate-bromide using methyl orange as indicator.

Critical Summary

Kolthoff[22] has summarised critically the available bromometric procedures for the determination of phenol. Direct bromination of phenol, by which tribromophenol bromide is precipitated, may be applied to the determination of phenol by any one of three procedures:—

(1) Gravimetrically by weighing the precipitate. The accuracy here is increased by precipitating in presence of sodium acetate and washing the precipitate with dilute bromine water.

(2) Titration of the liberated hydrobromic acid. More accurate results are obtained here by removing excess bromine by shaking with mercurous chloride, instead of by aeration or extraction with an organic solvent. If the mercurous method is used, the indicator should be bromocresol green, bromothymol blue, or chlorophenol red, and not methyl red which reacts with mercurous chloride.

(3) Iodometric determination of the fourth bromine atom in the tribromophenolbromide by treating the washed precipitate with potassium iodide and titrating the liberated iodine with sodium thiosulphate. With the modifications suggested, the respective accuracies for the three methods are 2 per cent low, 1-2 per cent high and 2 per cent low.

Iodimetric methods have also found wide-

spread use in the analysis of phenols. Kothoff[23] has shown that hydroquinone is oxidised by molecular iodine forming 1 molecule of quinone and 2 molecules of hydriodic acid. For the successful iodimetric titration, it is necessary that the *p*H of the solution at the end of the titration be somewhat greater than 5. In the same paper, Kolthoff described a dichromatometric procedure for the determination of hydroquinone and lists the best conditions for this titration. The latter titration can be effected electrometrically in the presence of considerable amounts of acid, but, since the quinone formed poisons the electrode, it is necessary to heat the electrode to redness after each titration.

Satisfactory Titration

Benzoquinone can be titrated satisfactorily with a solution of iodine in chloroform, and hydroquinone can be oxidised with ferric chloride in water, and the benzoquinone extracted with chloroform and titrated iodimetrically. Using this procedure Bock and Lock[24] determined hydroquinone in presence of phenol, resorcinol, pyrogallol and other phenols, since these either do not give an oxidation product with ferric chloride or this product is insoluble in chloroform. Catechol interferes, and must be removed by precipitation with lead acetate.

Electrometric titration methods are often of value when visual end-point procedures break down. Kolthoff[25] has shown that phenol and the cresols can be accurately titrated electrometrically with alkali in 0.1N or 0.01N solution. Vanillin and sodium phenol sulphonate can be similarly titrated. In salicylic acid, the hydroxyl group loses its acidic character and cannot be titrated, but its esters, e.g., salol or methyl salicylate, can be titrated accurately as phenols. Thymol and β-naphthol also give satisfactory results. Of the dihydroxybenzenes, catechol behaves as a monobasic acid, while resorcinol and hydroquinone behave as dibasic acids. Pyrogallol and phloroglucinol function as dibasic acids.

It is often necessary to titrate weak organic acids in alcoholic solution, sometimes because the salts of the weak acid are too much hydrolysed to permit an accurate titration. The addition of the alcohol always exerts an effect on the ionisation of the acid. It is desirable, therefore, to know the ionisation of weak acids in alcohol. Treadwell and Schwarzenbach[26] have shown how the ionisation constant can be computed, in many cases, from the results of electrometric titration. They determined the constants of many phenolic compounds of weakly acid character.

Chirkov[27] has determined as little as 1 μg. of phenol at a concentration of 10^{-5} by a micropotentiometric method. The method is based on measurement of the e.m.f. of the solution during its titration with sodium hypobromite, with the equivalent point found graphically on the titration curve as a definite break. The quinhydrone and smooth platinum electrode combination was found to be the most suitable.

Duyckaerts[28] has applied the modern amperometric titration technique to the determination of phenol with bromate. A predetermined slight excess of potassium bromate was added to a phenol solution contained in a rotating vessel. After 10 minutes a calomel and a platinum microelectrode (+ 0.2 v. with respect to the former) were introduced, and titration effected with four additions, each of 0.25 ml. of bromate solution. In this way the molarity of a 0.0165M solution of phenol was determined to 0.5 per cent. Sharp end-points were obtained by plotting galvanometer deflection against ml. of bromate, before and after the presence of bromine, the current being proportional to the concentration of bromine.

According to Schumann[29], the well-known Raschig procedure for the determination of *m*-cresol in tricresol may be improved by titrating with N sodium hydroxide to a phenolphthalein end-point instead of weighing trinitro-*m*-cresol. The procedure, however, breaks down when only small amounts of *m*-cresol are involved.

Useful Review

A useful review of earlier methods for the determination of cresols has been compiled by Munch,[30] who also proposed a new method for the determination. The cresols form salts with calcium hydroxide, which are more soluble in water than the reagent. If, therefore, cresol is added to a solution of calcium hydroxide containing undissolved calcium hydroxide, the calcium content of the solution can be determined before and after treatment with cresol by precipitation as oxalate and titration with potassium permanganate. No indication of the accuracy of the method is given by the author.

A titrimetric method for the determination of phenol and cresols in presence of each other has been proposed by Miklashevskaya.[31] When phenol is heated to 80° C. with potassium permanganate and dilute sulphuric acid, carbon dioxide and water are formed; under the same treatment cresol also forms acetic acid. The results obtained are based on the permanganate reduced and the acetic acid formed, as determined by suitable titrations.

The acid chlorides of the higher fatty acids react quantitatively with the hydroxyl group of a phenol (or an alcohol), evolving hydrochloric acid which can be measured alkalimetrically.[32] Thus, the dry sample (containing 10-20 mg.-OH) is added to 1/15 mole of stearyl chloride. The mixture is boiled gently, while dry air is passed through it and escapes into water forming an aqueous solution of hydrochloric acid, which is titrated with 0.05N sodium hydroxide. Carboxylic acids and sulphonic acids react similarly.

A solution of iodine monochloride in hydrochloric acid has been used by Gengrinovich[33] for the direct titration of phenols. The phenol solution, which should be approximately 0.1N, is acidified with 4N hydrochloric acid and titrated with the reagent against starch-iodine indicator. The method has proved successful with phenol, resorcinol and β-naphthol.

Rao and his co-workers[34] have developed a redox titrimetric method for the determination of hydroquinone solutions which are not stronger than 0.01M. The titrant is sodium orthovanadate, oxalic acid being used as catalyst and diphenylbenzidine as indicator. Titration is effected at 50°C. and in strongly acid (7M) medium. Resorcinol suffers induced oxidation when hydroquinone is oxidised by sodium metavanadate, but other phenols do not interfere.

Mention may be made of two methods for the titrimetric determination of resorcinol. The first is due to Veno and Suzuki[35] and depends on the nitrosation of resorcinol, the reaction proceeding very rapidly as follows:

$$C_6H_4(OH)_2 + 2HNO_2 \rightarrow C_6H_2(OH)_2(NO)_2 + 2H_2O$$

Small amounts of catechol do not interfere. The titration is carried out with 0.5N sodium nitrite solution in hydrochloric acid medium at 0°-5°C., starch-iodide paper being used as external indicator.

The second method involves the use of furfural,[36] and is briefly as follows:—Dissolve 0.1-0.2 g. of resorcinol in 50 ml. of 18 per cent hydrochloric acid and add the solution to about 0.7 g. of furfural in a 100 ml. flask. Stopper the flask, mix thoroughly, keep for 25 minutes on a water-bath at 38°-40°C., cool to 20°C. and dilute with water to 100 ml. Filter a portion of the solution and, to a 20 ml. aliquot, add a few drops of bromophenol blue and neutralise the hydrochloric acid at first with normal alkali, and complete the titration with 0.1N alkali to a violet colour. Prepare a blank solution of the same coloration, add 15 ml. of a 7 per cent aqueous solution of hydroxylamine sulphate, shake, and after a few minutes titrate the liberated sulphuric acid with 0.1N alkali to the colour of the control sample. The method is also applicable to mixtures containing resorcinol, phenol and catechol.

(To be continued)

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German Patent Law

Congress Debate whether Product is Patentable

AMONG the subjects of special interest on the agenda of the International Union Congress (Patents) in Vienna in June was the often debated question of whether *products* should be included within the scope of a patent grant. In the original German patent law of 1877, the product, with certain special exceptions, was generally excluded, and the suggestions of the German Chemical Society to this effect were accepted (see *Ber. deutsch. Chem. Soc.*, 1877, **10**, 507). The subject has been frequently debated since, in chemical and patent law circles, the latest discussions being those of the German Patent Law Society at Wetzler in August, 1951, and of the German Chemical Society at Cologne in September, 1951. At the last meeting there was by no means complete unanimity, although the majority was in favour of retaining the original rulings; that is to say, that there should be no fundamental change in the practice of adopting the system of Great Britain, the U.S.A., and some other countries where the product is usually included in the patent's scope.

Weighty Arguments

There are fairly weighty arguments on both sides and these were presented in an authoritative manner by Senate President Dr. H. Dersin, of Munch, in a recent report (*Angew. Chem.*, 1952, **64** (5), 128-133)—in this connection, it should be noted that foods and drugs are in a separate category for special treatment. The main points urged by the supporters of 'absolute product rights' are:

1. The fear that this would hinder chemical industrial development has been found to be groundless. It cannot be said to have proved very real in the U.S.A., Great Britain, or even in France in recent years (although Dr. Dersin thinks that, in France at all events, these product rights have proved a hindrance to development). In Germany such possible hindrance could be avoided by facilitating the granting of compulsory license (by amending Section 15).

2. With new synthetics 'product rights' would be practically the only ones of value to the inventor, since progress often lies in the adaptation of old methods to new products. Other illogical features may also be adduced.

3. Protection of the product appears very often to be the only method of giving the inventor a true reward, a point that can be argued at some length.

4. The grant of product rights would be a relatively simple matter for the examiners.

Dr. Dersin examines these various contentions in some detail, and although admitting their force, comes to the general conclusion that the counter arguments and proposals are the stronger, and there should be little or no change in this fundamental feature of German patent law as affecting the chemical industry. He points to the undeniable fact that, under her patent system, German chemical industry flourished exceedingly and became among the most potent and efficient in the world. The discussions and findings of the Vienna Congress, when received, will therefore be of considerable interest. The special case of foods and drugs, from the German point of view, has been ably reviewed by v. Kreisler in *Gewerbl. Rechtsschutz u. Urheberrecht*, 1951, **53**, 534-544.

Another important aspect of patent law, namely, the position of employee-inventors, is the subject of a new draft law by the Department of Justice in West Germany, and its provisions are dealt with at some length by Dr. Walter Beil, Frankfurt a/M. (*Chem. Industrie*, 1952, **4** (5), 346-349, May).

Seaweed Symposium

A PLEA for the better utilisation of seaweed and its potential value as an animal feeding stuff and in other ways was emphasised by the Secretary of State for Scotland, Mr. James Stuart, when he opened the first International Seaweed Symposium which began in Edinburgh on 14 July.

Scientists from some 20 countries gathered at the zoology department of Edinburgh University where nearly 30 scientific and technical papers on the development of seaweed utilisation and research in various countries were discussed.

Expanding Horizons for Oxo Petrochemicals

THE start of operations last April at the Tennessee Eastman Company's Longview, Texas plant, brings a new producer into the field of OXO petrochemicals. Commercial utilisation of the processes involved dates back to 1949 in the Western hemisphere, when Esso Standard Oil Company converted its high-pressure hydrogenation stalls at Baton Rouge to OXO conversion. Considerable improvements have been made during the few intervening years as other petroleum refiners and chemical companies have entered this promising field.

To the petroleum refiner, the OXO process offers a means for upgrading by-product olefines to valauble aldehydes and alcohols. The underlying reaction is highly flexible with regard to raw material, and allows ready adaptation to the changing demands of the market.

The basic OXO reaction is a development of the cobalt-catalysed Fischer-Tropsch process which was practised in war-time Germany. It involves the condensation of water gas (i.e., a mixture of carbon monoxide and hydrogen) with an olefine, according to the reaction:

$$R-CH=CH_2+H_2+CO \rightarrow R-CH_2-CH_2-CHO$$

or $R-CH(CHO)-CH_3$ ... ... (1)

The versatility of the reaction is considerable. It can, in effect, be employed with all mono-olefines, ranging from ethylene to pinene. In each case, straight-chain and α-methyl aldehydes are formed. The proportion of these products depends on the amount of steric hindrance encountered. Thus, *iso*butylene will yield more CH_3—CH-$(CH_3)-CH_2-CHO$ than $CH_3-C(CH_3)_2-$CHO. In the OXO treatment of the simpler olefines, it may be stated as a rough rule that the aldehydic product is 60 per cent branched-chain and 40 per cent straight-chain.

Cobalt or Iron Catalysts

The OXO reaction has been successfully carried out in the presence of both cobalt and iron catalysts of the Fischer-Tropsch type. The preferred catalyst is the standard Fischer-Tropsch cobalt catalyst, containing 30 per cent cobalt, 2 per cent thoria, 2 per cent magnesia, and 66 per cent kieselguhr.

The conditions of the reaction are relatively mild. Depending on the nature of the olefine to be OXO treated, the reaction temperature is between 225 and 315°F. The reaction is preferably carried out at pressures of about 3000 p.s.i.

The OXO reaction is always carried out in the liquid phase. Where the raw materials are gaseous olefines at operating conditions, it is necessary to employ an auxiliary solvent. Usually an inert hydrocarbon is selected which differs in boiling point sufficiently from the resulting aldehydes to permit ready separation by fractionation.

Reaction Temperature

The reaction temperature selected depends on the olefine employed. The low-molecular weight olefines are generally reacted at somewhat higher temperatures than the higher olefines. The OXO reaction proceeds in better yields at the higher temperature while the danger of double-bond isomerisation does not exist for the gaseous olefines. The lower olefines give yields of only about 75-80 per cent, while the higher olefines can be converted with 90 per cent efficiency. Propylene in cetane can be OXOtreated at temperatures above 175°F. However, a satisfactory reaction rate cannot be obtained below 200°F. The OXO reaction with olefines which are normally liquid can be effected at temperatures as low as 120°F. but is also preferably carried out above 210°F. in order to obtain a better reaction rate.

To effect an adequate partial pressure of water gas, it is necessary to operate at elevated pressures, usually in the range of 1500-3000 p.s.i. The water gas composition is generally equal volume parts of carbon monoxide and hydrogen, i.e., the theoretical ratio. Higher hydrogen ratios tend to increase the amount of hydrogenation, while a water gas rich in carbon monoxide favours isomerisation of the double bond position. Within the vicinity of the 1:1 carbon monoxide-to-hydrogen ratio, the exact com-

position of the water gas does not appear to be critical.

The extent and rate of the OXO reaction is greatly dependent on the pressure. In one series of laboratory runs, a pressure of 750 p.s.i. gave a conversion of only 10 per cent, while a pressure of 3,500 p.s.i. (keeping all other conditions constant) resulted in an OXO product yield of fully 95 per cent.

The degree of intimacy of contact between water gas and the liquid phase determines the normal reaction time. In batch systems, proper mechanical agitation must be provided, while in continuous systems the necessary contact can be achieved by proper design of the flow characteristics of the reactor.

In Slurry Form

In one version of the commercial OXO process, the cobalt catalyst is added in the form of a slurry and is carried as such through the reaction stage, after which it is filtered off. In the course of the reaction, cobalt carbonyl is formed, some of which leaves with the effluent gases. Most of the cobalt carbonyl can be recovered by scrubbing with hydrocarbons.

An appreciable portion of the cobalt in the feed remains dissolved in the product of the OXO reaction and passes through the filters. If the aldehydic product is used solely as an intermediate for the ultimate production of alcohols, no special treatment is required. Cobalt is quite insoluble in the product alcohols and settles out in the course of hydrogenation, ready to be filtered and reused. If, on the other hand, aldehydes are desired as the final product, special treatment is necessary to remove the dissolved cobalt. For the lower aldehydes, this may be brought about by distillation, while the higher homologues can be effectively treated with dilute sulphuric acid.

Attempts have been repeatedly made to overcome these glaring disadvantages of slurry-type operation by the use of fixed-bed OXO catalysts. This approach is made difficult by the formation of volatile cobalt carbonyls and by the inferior physical properties of the standard catalysts.

In order to minimise the problem of purification, it is universally necessary to start with a pure olefinic stock. Even so, however, the product will consist of a mixture of isomeric aldehydes which must be separated for most sales purposes. Aldehydes are, however, too reactive a group of compounds to withstand temperatures required for the distillation of homologues above C_5. In such cases, as in the event where the alcohol is the desired end-product, the aldehyde mixture is subjected to hydrogenation. The resulting alcohols are much more stable and can therefore be more readily fractionated. A mild oxidation will convert the purified alcohol to the aldehydic form.

At the moment, the more important markets are for the alcohol derivatives of the OXO product. Even a portion (up to 40 per cent) of the primary product is in the form of alcohols (aldehydes can be preferentially produced by the addition of small amounts of sulphur compounds to the feedstock, which will inhibit the hydrogenating power of the catalyst without great influence on its effectiveness in OXO treatment).

The OXO aldehydes can be converted to alcohols in a separate hydrogenation stage. The cobalt catalyst from the OXO stage may itself serve in this function, but other well-known hydrogenation catalysts may serve this purpose with equal success.

The presence of carbon monoxide obstructs the hydrogenating ability of the catalyst. It becomes necessary, therefore, to release the pressure between stages and to maintain an atmosphere of pure hydrogen in the secondary phase. Residual carbon monoxide is destroyed by methanisation, of the recycle hydrogen stream according to the reaction:

$$CO + 3H_2 \rightarrow CH_4 + H_2O \quad \ldots\ldots\ldots\ldots \quad (2)$$

If a sufficiently pure olefinic charging stock has been employed, it is possible to purify the alcohols by simple fractional distillation. For more complex mixtures, more intricate methods of separation are available.

Major Applications

Major applications for the long-chain primary alcohols which can be produced uniquely by OXO reaction followed by hydrogenation are in the fields of plasticisers and detergents. The latter use especially is acquiring rapidly growing significance.

In the production of the lower molecular weight aldehydes and alcohols, OXO is proving a competitively significant process. Tennessee Eastman Company is using this route for the production of butyraldehyde, which has hitherto been wholly derived from expensive *n*-butanol. Even propionaldehyde can be synthesised by OXO treatment of ethylene.

The Chemist's Bookshelf

INDUSTRIAL AND MANUFACTURING CHEMISTRY. Part 1—Organic. Seventh edition. By G. Martin, revised by E. I. Cooke The Technical Press, Ltd., London. 1952. Pp. 752. 90s.

The first edition of this book appeared in 1912 and a decade later the sixth edition was being printed, a tribute to its popularity. Over twenty years passed, however, before the sixth edition was reprinted; but now the organic section has been totally revised and brought out in a separate volume. The task of the reviser, E. I. Cooke and his team of collaborators has been a considerable one, the chemical industry has grown enormously in the last twenty years, and the accent has moved from one industry to another. We can sympathise with him, then, when he writes in the preface to the seventh edition 'I marvelled that such a wide field had been covered in so little space'. It is important to stress at the outset that this virtue has been preserved, and the amount of information contained in this medium sized portable volume is staggering. The work was originally conceived as a reference book on the applications of chemistry to the arts and manufactures, and again this conception has been maintained by the inclusion of a quantity of theoretical material.

The book is divided into 24 separate sections each covering an industry or group of related industries, and being subdivided into chapters on specialised topics. It is impractical even to name all the subjects mentioned, and so two chapters have been chosen at random, and considered in detail. The plastics industry may be taken as representative of those in which the organic chemical produced is an end in itself, and the industry of photographic chemicals as representative of those in which the organic chemical is produced as a means to an end. Fortuitously, these two chapters illustrate the weakness and the strength of the book. The plastics industry is on the whole very well documented, and although the separate manufacturing organisations may prefer to keep secret details of their manufacturing plant or their compositions, a large quantity of basic information is still available, and this state of affairs has been assisted by the publication of reports upon German methods and materials used during the war. It is less surprising, then, that the appropriate chapter is full and informative, than that it is readable and of moderate length. In the case of polythene, for example, the history, chemical manufacture, chemical and physical properties, compounding and applications are all given in some detail. It is inevitable, of course, that overgeneralisation should take place, and such meaningless phrases as 'polythene is reduced to a powder by a patented process' occur. In fact there are at least three methods of performing this difficult operation, each employing an entirely different principle.

In the table giving the grade, viscosity, and average molecular weight of various polythenes, the average molecular weight of Grade 200 is said to be 22,000, greater than that of Grade 2. Other authorities suggest that the figure should be nearer 13,000. Polyvinyl chloride is described in much less detail, and no differentiation is made between the various methods of dehydrochlorination of ethylene dichloride, a process which may become increasingly important as ethylene from petroleum cracking becomes available.

In the case of the photographic industry, publication has tended to be confined to the utilisation of photographic materials, rather than their manufacture, and the large photographic firms have kept their methods and the composition of their emulsion additions secret. This situation is reflected in the chapter entitled 'The Industry of Photographic Chemicals' which is short, vague, confused, and frequently misleading. Almost none of the dyes said to be used as sensitisers has been used since the early twenties, and

many had only a theoretical interest at that date. All the cyanines are now prepared by methods which are not described, but which are available in the patent and scientific literature. The section dealing with colour photography is confined to a brief description of the earliest principles, an account of how a modern tripack is developed, and an arbitrary collection of patents said to be connected with the production of coloured images. This small selection from the enormous number that have been filed contains some which have had no manufacturing application whatever. This section should have consisted of a description of the mode of formation of coloured images, an account of the common types of colour formers and developers, and a list of the marketed processes. Space could have been found by cutting out the section dealing with flash powders which are little used today. The whole of this chapter should be drastically rewritten and much of the material which has only the mildest historical interest omitted. In its place there should be some account of the modern photographic industry with its special plates for nuclear research, a development which has made Britain pre-eminent in cosmic ray research, its emulsions sensitive to light of all wavelengths, and its wide use of organic chemicals for sensitising, dyeing, stabilising and toning.

It is only fair to repeat that this severe criticism is confined to the chapter described. The bulk of the material to be found in this book is useful information and up to date. It will be invaluable to anyone connected with the chemical industry.—J.R.M.

TECHNICAL CO-OPERATION WITH UNDERDEVELOPED COUNTRIES. By P. C. Newman, J. E. Ullmann and R. S. Aries. Chemonomics, Inc., New York. 1952. Pp. ii + 97. Price $5.

This booklet is one of a series of studies conducted by R. S. Aries and associates, consulting engineers and economists, which was originally intended for distribution to the clients who initiated the studies and other special groups. In view of a wider interest, however, the organisation has decided to give the results they obtained a bigger circulation by putting them on the market in book form. This particular book was compiled from collected data because the many foreign assignments carried out by the company showed that there was a need for such a survey.

The wealth of exploration and research that have gone into the making of it are evident in the first ten pages. The three authors are an economist, an industrial engineer and a chemical business man, and between them they have produced an objective, extremely factual account of the way in which undeveloped areas of the globe can be developed. Extracting significant statistics from what must have been a welter of figures, they demonstrate the potentialities, means, and effects, of industrialisation, discuss methods used in the past, and take into account the activities of local Governments and national and international organisations which no venture into undeveloped territory nowadays can afford to ignore. Present plans for development of the countries concerned—and the cases of several countries, such as Iran and Brazil, are cited —are subjected to an exceedingly critical and straightforward analysis. Other chapters are devoted to 'grass roots' industrialisation, or the essential integration of industrialisation with a rehabilitated agriculture, and the organisation of technical assistance both as it now is, and as it can be developed.

One overwhelming advantage possessed by this book is that its progenitors are not Government officials. If Whitehall or the White House were to issue statements in an official publication such as are to be found throughout this book, there would be an international crisis of the first magnitude. Governments and Government surveys have, up to comparatively recently, had a near monopoly (except for private firms prospecting privately) in this kind of exploratory work, and it is refreshing to read in an unclassified publication authoritative reports and opinions which would normally be found only in the Diplomatic Bag. Apart from this, its value to businessmen and any of the public who care to read it should be great, for it provides an economic background to present political trends in the countries dealt with that makes these sometimes baffling movements easier to understand. The book is written in a swift, concise prose that makes its backbone of statistics more interesting to read than one would have believed possible. —J.C.S.

HOME

Edible Oil Refinery

The foundation stone of what it is claimed will be the largest edible oil refinery in the world was laid at Bromborough, on 8 July, at the margarine works of Van den Berghs and Jurgens, Ltd. The steelwork has already been erected, but it is expected that it will take some 18 months or two years to complete. The new refinery, which it is stated will cost nearly £750,000, will contain 2,000 tons of steel.

Tungsten Ore Prices

A reduction in the selling price of tungsten ore (standard 65 per cent grade and ordinary quality) from 467s. 6d. to 447s. 6d. a long ton unit, delivered consumers' works, with effect from 12 July, has been announced by the Ministry of Materials. This is based on the current buying price of 425s. c.i.f.

Fertilisers and Food Production

A long-term scheme to publicise the important part played by fertilisers in food production is being organised by the Fertiliser Manufacturers' Association in collaboration with the Superphosphate Manufacturers' Association. The campaign is not an advertising one but is intended to reach the agricultural community and the public and to assist them with advice and by the dissemination of information. It is also intended to assist member firms with their individual advertising schemes.

Price Reductions

The Ministry of Materials has announced that decreases in the permitted maximum prices of most fertilisers (except basic slag, of which the prices for most grades were reduced last month) took effect on 16 July. The decreases are due to falls in freight rates, the cost of bags and other causes. The price of sulphate of ammonia was reduced by 8s. a ton; 'Nitro-Chalk' by 3s. a ton; compound fertilisers go down by approximately £2 a ton; ground rock phosphate goes down by £1 14s. a ton; superphosphate by £1 11s. a ton, and the higher grades of potash go down by 14s. to 19s. a ton. There is an increase of 3s. 6d. a ton in respect of 40 per cent grade potash and of 11s. 6d. a ton for 48 per cent grade sulphate of potash.

Coke Production Scheme

Details of a coal carbonisation scheme for the Durham coalfield to cost £21,000,000 were announced on 14 July. The plans are related mainly to the needs of British industry, particularly iron and steel. Some obsolete plant will be replaced and new batteries of coke ovens built. One of the main schemes is the building of a new 50-oven battery with by-product plant alongside a new shaft. There will also be a new washer and power station. The project is expected to be completed in 1957.

Science and Industry

A general discussion on science and industry will take place at 5.30 p.m. on 22 July when the General Committee of the Parliamentary and Scientific Committee meets in Committee Room 12, House of Commons. The discussion will be based on the debate which took place in the House of Lords in June, the DSIR Advisory Council Report for 1950-51 and replies to the questionnaire circulated by the secretary to members of the Committee prior to the debate.

Approved Products

A new list of officially approved crop protection products—insecticides, fungicides and weed-killers—has just been issued by the Ministry of Agriculture and Fisheries. Approval is granted in respect of products which comply with the standards of composition and performance approved by the Ministry of Agriculture and Fisheries and the Department of Agriculture for Scotland for the purpose stated on the containers.

Metal Allocations

Third quarter allocations of tungsten, molybdenum and copper, as announced by the International Materials Conference on 11 July, include 100,300 metric tons of copper for Britain compared with 97,200 tons in the second quarter. She has been given an allocation of 950 metric tons (metal content) of tungsten and concentrates for distribution as ore and concentrates and 50 tons for export as primary products. An import quota of 995 metric tons of tungsten ores and concentrates was also fixed for Britain.

• OVERSEAS •

New Chemical Standards

The Indian Standards Institution has recently published Indian standard specifications for sodium sulphide, technical, alumino-ferric and potassium nitrate, technical. The standards prescribe the requirements of description and composition, and the methods of test for these materials. Each standard has two appendices, one on sampling and the other on chemical analysis.

Copper Extraction

The Cyprus Mines Corporation recently opened a large new plant at Xeros which will greatly increase copper extraction. The plant is designed to produce sulphuric acid from copper ore by a heating process during which gas is produced. The gas is then condensed in the form of sulphuric acid. In the course of the process, copper is produced which would otherwise be lost, and the acid is further used in the treatment of copper ore to produce a greater percentage yield.

Detection of Vitamin B_{12}

A quick method for the estimation of vitamin B_{12} has been developed by Pfizer & Company of New York, it is reported. The test is a colorimetric one and relies on the distinctive red colouring of the vitamin and the purple colour produced by the addition of cyanide. On the addition of cyanide, a spectrophotometer is used to determine the shift in colour and hence the amount of the vitamin present in the material. This method is far quicker than the biological assay, it is claimed, which depended on the accelerating effect of the vitamin on the growth of certain micro-organisms.

Distillation Columns Landed

Installations to form part of a big Australian oil refinery that is being built at Geelong, Victoria, include distillation columns between 85 ft. and 105 ft. high. Wharf cranes could not handle these and they were lifted out of the ship's hold and landed on to transport lowboys by ship's tackle. The refinery, which is being built by the Shell Company of Australia, Ltd., will be capable of handling 308,000,000 gallons of crude oil a year. It will cost over £A5,000,000 and is expected to be completed by 1954.

Synthetic Rubber Exports

The U.S. Commerce Department has announced that it will allow the export of 2,500 long tons of Government-produced butyl rubber in the third quarter of this year. It will be the first time in two years that overseas shipment of the synthetic, known as GR-I, has been permitted.

Plastic-Fortified Concrete

A concrete fortified with polyvinyl acetate is reported from the U.S.A. to be twice as strong as ordinary concrete. The material was reported to the American Chemical Society to have great potential uses as roads, floors and masonry. Increased resistance to cracking, corrosion, abrasion, and impact is claimed for it, and the mixture is said to be self-curing in air at ordinary temperatures and humidities.

To Expand Gas Plant

It was recently announced that Shell's gas plant at Jumping Pound, Alberta, which began production about a year ago, is to be expanded by over one-third of its present capacity (25 million cu. ft. of natural gas daily), and will soon be supplying an additional 10 million cu. ft. daily for domestic and industrial use in Alberta.

Inorganic Chemistry Congress

A five-day International Congress on Inorganic Chemistry was held in Gothenburg, Sweden, last month. About 400 scientists from twenty countries participated. Delegates came from Australia, Brazil, Canada, Japan, South Africa, the United States and all West European countries. Arranged by the Swedish Academy of Engineering Sciences and the Chalmers Technical College of Gothenburg, it worked in nine sections.

Plastics Industry's Difficulties

The Swedish plastics industry is reported to be encountering difficulties owing to German and British competition and to sales resistance. It is feared that some factories will have to close down for a time. At present there are 250 factories with a total of 5,000 to 6,000 employees in Sweden. About 60 to 70 per cent of these are small firms, and it is mainly these that are expected to cease operations.

PERSONAL

DR. W. I. PUMPHREY, M.Sc., Ph.D., F.R.S.A., manager of the Research Department of Murex Welding Processes Limited, Waltham Cross, Herts, has been made a Freeman of the City of London and a Liveryman of the Worshipful Company of Blacksmiths.

DR. J. G. KING, O.B.E., D.Sc., Ph.D., A.R.T.C., F.R.I.C., has retired from the position of Director of the Gas Research Board on the occasion of the taking over the work and assets of the Board by the Gas Council, which now governs the nationalised gas industry. He is now undertaking consulting work.

Dunlop announce the appointment of MR. GEORGE VAUGHAN, technical manager of their tennis racket factory at Waltham Abbey since 1944, to succeed MR. N. GUY PROCTOR as manager. Mr. Vaughan, who is 44, began his business career with Imperial Chemical Industries (Metals) Ltd., at Witton, Birmingham, and joined Dunlop in 1928.

MR. N. GARROD THOMAS, C.B.E., M.A., M.Sc., retired on 30 June from his post as general manager of The National Sulphuric Acid Association Ltd., a post which he had held since the inauguration of the Associasulphuric acid industry during the 1914-18 tion in 1919. He became interested in the war when he joined the Ministry of Munitions Explosive Supply Department. At the end of the war, at the suggestion of the Departmental Committee on the Post-War Position of the Sulphuric Acid and Fertiliser Trades, the National Sulphuric Acid Association was formed and Mr. Garrod Thomas was asked to become its general manager. When the second world war broke out in 1939, he was appointed Controller of Sulphuric Acid by the Minister of Supply and held this position until the Control was brought to an end in 1950. During his thirty-seven years in the sulphuric acid industry he has been instrumental in fostering and cementing good relations with the suppliers of raw materials from overseas.

Mr. Garrod Thomas was educated at Rugby School and was a Brackenbury scholar of Balliol College, Oxford, where he obtained first class honours in chemistry and later served as a College Tutor in Chemistry. He also obtained the degree of Master of Science at Harvard University, Cambridge, U.S.A. On leaving Oxford he was called to the Bar where he practised until the outbreak of the 1914-18 war.

MR. HENRY NORMAN RYDON, assistant professor at the Imperial College of Science and Technology, has been appointed professor of chemistry in the Faculty of Technology in Manchester, and will take up his appointment in October.

MR. M. K. SCHWITZER, A.M.I.Chem.E., of Armour & Co., Ltd., has been appointed manager of their Chemical Division Europe. The Chemical Division deals with the whole range of fatty acids and their derivatives produced by Armour's new plant at McCook, Illinois.

Mr. Schwitzer is known to the industry for a number of scientific papers dealing with various aspects of the oils and fats industry, and particularly for his book "Continuous Processing of Fats" published last year.

MR. GEORGE H. SEARLE, chief chemist of T. Wall & Sons, Ltd., ice-cream and meat-products manufacturers, made a presentation on 4 July to the retiring secretary of the company, MR. G. L. PRATT, on behalf of fellow workers. Mr. Searle said that he and Mr. Pratt had been colleagues for 27 years.

Palm Oil to Cost More

Changes in the price of unrefined oils and fats to be allocated to primary wholesalers and large trade users during the four-week period ending 9 August have been made by the Minister of Food, as follows:—Palm oil raised from £100 to £105 a ton c.i.f. in bulk; £101 to £106 in loan drums; and £101 10s. to £106 10s. in casks to be returned. Whale/herring/seal acid oils reduced from £60 to £50 a ton, naked ex works. Acid oils, ex hardened oils, reduced from £75 to £60 a ton. Mixed acid oils, ex margarine and compound refineries, reduced from £75 to £60 a ton.

Publications & Announcements

A PAMPHLET entitled 'Wax Chemistry and Technology' has recently been published by L. Ivanovszky, D.Sc., Dipl.Ing., F.R.I.C., M.I., Chem.E., F.Inst.Pet. This endeavours to classify knowledge of waxes from its present chiefly empirical basis and to establish a wax technology on scientific lines. Stressing the importance of the physical chemistry of waxes, Dr. Ivanovszky says that too little is known about the physical properties of waxes that make them what they are. Time-honoured trial-and-error methods are not adaptable to change if raw materials become scarce, or if the wax no longer satisfies the user. This is certainly true, but it is difficult to see how this treatise does very much to rectify the situation. Dr. Ivanovszky does little more than summarise established facts and suggest a scheme for classifying them, without doing anything to replace the trial-and-error methods that he condemns. Moreover, the 'fundamental knowledge' of waxes provided by the author is no more than the average manufacturer knows already, and considerably less than this on the practical side. Sections on the history and etymology of waxes, while they are interesting, tend merely to make the monograph less comprehensive in its main field, that of classification. It is difficult to see at whom this publication is aimed. Students would find it a very useful and broad elementary summary of the wax field, but Dr. Ivanovszky has patently not written it for students. The monograph was originally published as a paper in four parts in *Soap, Perfumery and Cosmetics* last year.

* * *

'NATURAL Rubber Latex and its applications' is the title of a new book by Dr. Henry P. Stevens (late consultant to the Rubber Growers' Association, Inc.) published by the British Rubber Development Board. The first edition of the book appeared under the title of 'Latex' in July, 1928, and the last 20 years later. Such advances have been made in the study and utilisation of latex in recent years that it was decided to re-write the work rather than attempt revision. Furthermore, so many new applications have been developed and reached a manufacturing scale, that it was impracticable to combine them adequately in one volume. The present book dealing with a general account of the origin, nature, production and properties of latex is the first of a series.

* * *

In the summer number of *Rubber Developments* (Vol. 5, No. 2) issued by the British Rubber Development Board, a general review of the modification of natural rubber by synthetic polymers is given by Dr. G. F. Bloomfield, of the British Rubber Producers' Research Association, and the development and application of cyclised rubber is discussed by Dr. C. M. Blow.

* * *

EFFICIENT operation of factories and plant is a matter which today engages the attention of both management and engineering staff. One aspect, apt to be overlooked, is that of power factor improvement. An article on this subject which appeared in the Federation of British Industries' annual publication *Fuel Economy Review*, 1949, has now been amplified by the author, Mr. H. A. Jones (British Insulated Callenders Cables, Ltd.) and has been issued by the technical department of the FBI as 'Power Factor Correction, Fuel Economy Monograph, No. 6,' price 3s.

* * *

THE journal of the British Cast Iron Research Association (Vol. 4, No. 5) for April, 1952, has recently been published by the council of the Association, at Alvechurch, Birmingham. This publication is now available on subscription to non-members of the Association. Typical papers which have appeared recently have dealt with some fundamental and original work on the fluidity of cast iron, methods of improving working conditions in iron foundries, an investigation of the relationship between the stress/strain properties of moulding sands and expansion scabs on iron castings, a method for the quantitative spectrographic analysis of slags, and a detailed study of the harmful effect of certain residual elements in magnesium-treated nodular iron and its neutralisation by cerium. These are given in an index to Vol. 3, which itself contains three papers reporting recent research.

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Twenty-first Anniversary

Industria Britanica Comes of Age

'I DO not think it is possible to exaggerate the importance of a journal such as this in promoting trade,' declared the Rt. Hon. Selwyn Lloyd, C.B.E., Q.C., M.P., Minister of State for Foreign Affairs, at a luncheon at Grosvenor House, Park Lane, London, W.1, on Thursday, 10 July, on the occasion of the 21st anniversary of *Industria Britanica*, a sister journal of THE CHEMICAL AGE, published by Benn Brothers Ltd. 'We do feel,' he said, 'that it has performed, and will continue to perform, a very useful function.'

Commercial relations between Great Britain and Latin America had always had their foundations in trust, honesty and fair dealings, commented the Peruvian Ambassador, Dr. D. Ricardo Rivera Schreiber, K.B.E. British products, from the simplest to the most complicated, enjoyed the prestige belonging to high-quality manufacture. 'Our development as new-born states,' he said, 'also owes much to Great Britain who contributed decisively with loans, machinery, technical advice and the building of railways. . . During a century and a half, the Latin American Republics have always regarded Britain as the standard bearer of those political institutions which are the cornerstone of our existence.'

There was, the Ambassador remarked, a growing purchasing power in the Latin-American markets, and it was their desire to work towards the increasing of their relations with Britain now and in the future. 'How fortunate we are to have in *Industria Britanica* an ambassador to promote these interests,' said Dr. Rivera Schreiber. 'Vigorously stimulating the growth of commerce, *Industria Britanica* holds first place among commercial journals in the Spanish language. Its technical information and articles, so effectively illustrated, make it the most sought after journal of its kind in the Hispanic world.'

Market Reports

LONDON.—Conditions in the industrial chemicals market have shown little change during the past week although a slight improvement in the home trade has been reported. Interest in textile chemicals is perhaps rather better but the fine chemicals market is reported to be slow. Export trade is well maintained in spite of keen competition.

Most prices continue at recent levels but the lead compounds are lower on the reduction in the price of the metal. The new basis prices are: red lead £154, ground in oil £178 10s.; orange lead £166, ground in oil £190 10s.; white lead £165, ground £184 10s.; litharge £154.

The position of the coal tar products market remains the same as in previous weeks and no special feature is reported in this section of the market. The price of medium soft pitch has been increased to 160s. for the home market with the export price remaining in the neighbourhood of 200s. per ton f.o.b.

MANCHESTER.—Lancashire industrial holidays are still exerting their influence on the consumption of heavy chemicals and this factor is likely to operate over the next six weeks or so. The demand for chemicals for the textile and allied trades continues at below the normal level and this is affecting business in dyestuffs and certain coal-tar products on the Manchester market. Apart from these quieting influences, however, there is a fair aggregate demand on home consumption account and also for shipment. In most lines prices have been maintained, the slight fresh easiness has developed in the lead products. Only a quiet trade has again been reported in most fertilisers.

Iron and Steel Tribunal

A sitting of the Iron and Steel Arbitration Tribunal took place at The Church House, Westminster, S.W.1, on 14 July, 1952, at 10.30 a.m., when the application of Mr. H. A. Benson, Stockholders' Representative for the Staveley Iron and Chemical Co., Ltd., was heard. This was an application for the determination of the value for the purposes of Section 15 of the Iron and Steel Act, 1949, of the shares in the capital of the company. The proceedings were in public.

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The engagement of persons answering these advertisements must be made through a Local Office of the Ministry of Labour or a Scheduled Employment Agency if the applicant is a man aged 18-64 inclusive, or a woman aged 18-59 inclusive, unless he or she, or the employment, is excepted from the provisions of the Notifications of Vacancies Order, 1952.

CHEMICAL ENGINEERS for Process Design and/or Development Work are required by **THE BAHREIN PETROLEUM COMPANY, LTD.** Degree or Chartered applicants only considered, who must have had a minimum of three years' experience in this type of work. Salary in accordance with qualifications and experience, on successive two-year agreements with paid local and home leaves. Board, air-conditioned living accommodation and medical attention are provided in addition to salary, with low living costs, pension scheme and kit allowance. Age limits, 25 to 40 years. Apply, with full particulars of qualifications, experience, etc., to **BOX No. 5933, c/o CHARLES BARKER & SONS, LTD., 31, BUDGE ROW, CANNON STREET, LONDON, E.C.4.**

EXPERIMENTAL OFFICERS AND ASSISTANT EXPERIMENTAL OFFICERS in various Government Departments. The Civil Service Commissioners invite applications for permanent appointments to be filled by competitive interview during 1952. A closing date for the receipt of applications earlier than December, 1952, may eventually be announced either for the competition as a whole or in one or more subjects.

The posts are divided between following main groups and subjects (a) Mathematical and Physical Sciences. (b) Chemistry and Metallurgy, (c) Biological Sciences, (d) Engineering subjects and (e) Miscellaneous (including e.g. Geology, Library and Technical Information Services).

AGE LIMITS: For Experimental Officers, at least 26 and under 31 on 31st December, 1952; for Assistant Experimental Officers at least 18 and under 28 on 31st December, 1952. Extension for regular service in H.M. Forces.

Candidates must have obtained, or be taking examinations during 1952 with a view to obtaining, the Higher School Certificate with mathematics or a science subject as a principal subject, or the General Certificate of Education in appropriate subjects, or the Higher National Certificate or other specified qualifications. Candidates without such qualifications may be admitted exceptionally on evidence or suitable experience. Candidates over 20 will generally be expected to have higher qualifications.

Inclusive London salary scales; Experimental Officer £628-£786 (men); £533-£655 (women). Assistant Experimental Officers £275-£586 (men); £275-£489 (women).

Starting pay according to age up to 26. At 18, £275; at 26, £498 (men), £467 (women). Somewhat lower rates in the provinces.

Further particulars and applications forms from the **CIVIL SERVICE COMMISSION SCIENTIFIC BRANCH, TRINIDAD HOUSE, OLD BURLINGTON STREET, LONDON, W.1,** quoting No. S.94-95/52. Completed application forms should be returned as soon as possible. 16327/100/JW.

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SITUATIONS VACANT

SENIOR SCIENTIFIC OFFICERS; SCIENTIFIC OFFICERS; PATENT EXAMINER AND PATENT OFFICER CLASSES. The Civil Service Commissioners invite applications for permanent appointments to be filled by competitive interview during 1952. Interviews will continue throughout the year, but a closing date for the receipt of applications earlier than December, 1952, may eventually be announced. The Scientific posts are in various Government Departments and cover a wide range of Scientific research and development in most of the major fields of fundamental and applied Science. The Patent posts are in the Patent Office (Board of Trade), Admiralty and Ministry of Supply.

Candidates must have obtained a University Degree with first- or second-class honours in an appropriate Scientific subject (including Engineering) or in Mathematics, or an equivalent qualification; or for Scientific posts, possess high professional attainments. Candidates for Senior Scientific Officer posts must in addition have had at least three years' post-graduate or other approved experience. Candidates for Scientific Officer and Patent posts taking their degrees in 1952 may be admitted to compete before the result of their degree examination is known.

Age Limits: Senior Scientific Officers, between 26 and 31; for Scientific Officers and Patent Classes, between 21 and 28 during 1952 (up to 31 for permanent members of the Experimental Officer Class competing as Scientific Officers).

London Salary Scales: Senior Scientific Officers (men), £812-£1,022; (women) £681-£917; Scientific Officers (men), £440-£707; (women) £440-£576; Patent Examiner and Patent Officer Classes (men), £440-£655. (Rates for women under review.) Somewhat lower rates in the provinces.

Further particulars from the **CIVIL SERVICE COMMISSION, SCIENTIFIC BRANCH, TRINIDAD HOUSE, OLD BURLINGTON STREET, LONDON, W.1,** quoting No 853/52 for Senior Scientific Officers and 852/52, 8.128/52 for the other posts. 16045/120/WP.

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Stainless Steel **DRUM MIXER,** 4 ft. by 2 ft. wide.

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One plate and frame **PRESS** by Johnson with 22 C.I. plates and 23 frames, 4-port type.

One Jeffrey **GRINDER,** 72 loose hammers, shaker feed.

Two Turner 2½-sheet No. 2 **DRESSING MACHINES,** ball bearing.

Size No. 3 Junior Hammamac **HAMMER MILL** with fan and cyclone, also No. 1 size Miracle **GRINDING MILLS.**

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No. 200 One nearly new **WERNER PFLEIDERER JACKETED MIXER OR INCORPORATOR.** Low type, with C.I. built mixing chamber, 28 in. by 29 in. by 27 in. deep, with double "U"-shaped bottom which is jacketed, and double fish-tail or fin-type agitators geared together at one side, with belt-driven friction pulleys, 34 in. diam. by 5 in. face, with hand-wheel operation and hand-operated screw tilting gear. Machine fitted with machine-cut gears, covers, gear guard, cast-iron baseplate, and measuring overall approximately 7 ft. by 6ft. by 4 ft. high to the top of the tipping screw

No. 209 One **HORIZONTAL "U"-SHAPED MIXER,** steel built, riveted, measuring about 8 ft. 3 in. long by 3 ft. wide by 3 ft. 3 in. deep, with horizontal shaft, fitted with bolted-on mixing arms about 18 in. long by 4 in. wide, with intermediate breakers, and driven at one end by a pair of spur gears, with countershaft, fast and loose belt pulleys, outer bearing and plug cock type outlet at the opposite end, mounted on two cradles fitted to two R.S.J. running from end to end.

Two **FILTER PRESSES,** each fitted 68 wood recessed plates, 2 ft. 8 in. square, centre fed, with enclosed bottom corner delivery, cloth clips and belongings.

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Three recessed plate type **FILTER PRESSES** by Manlove Alliott, with 60 plates 24 in. sq., 1 in. thick. Hand operated ratchet and pinion closing gear.

S.J. copper **TILTING PAN** by Collier, 30 in. diam. by 24 in. deep. C.I. jacket to 12 in. depth. Hand tilting.

Two 40-gal. Kellis copper S.J. tilting **BOILING PANS.** 30 in. diam. by 26 in. deep. C.I. jacket for pressure 80 lb. sq. in. Hand tilting.

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TWO Broadbent **WATER-DRIVEN CENTRIFUGES,** 30 in. diam., 12 in. deep, 1,150 r.p.m., 150 lb. pressure.

FOUR Papier-mache O.T. **TANKS,** 8 ft. 6 in. diam., 8 ft. deep. (Unused.)

SIX O.T. TANKS, 7 ft. diam. 14ft. deep, lined inside with acid-resisting bricks.

SIX Aluminium **CONDENSERS,** 14 ft. long by 2 ft. 6 in. diam. 386 Tubes, ¾ in. o.d.

FOUR Rectangular Lead-lined **TANKS,** 8 ft. by 4 ft. 6 in. by 2 ft. 6 in.

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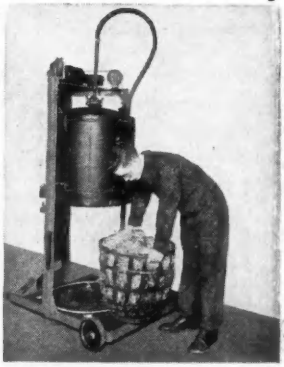

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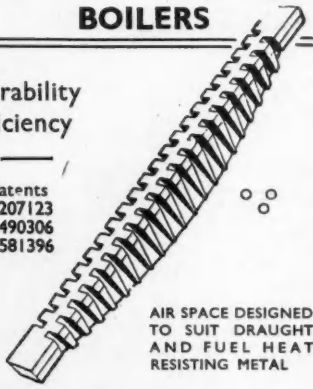
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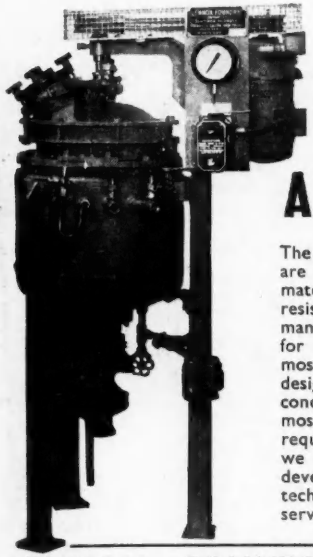

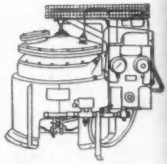

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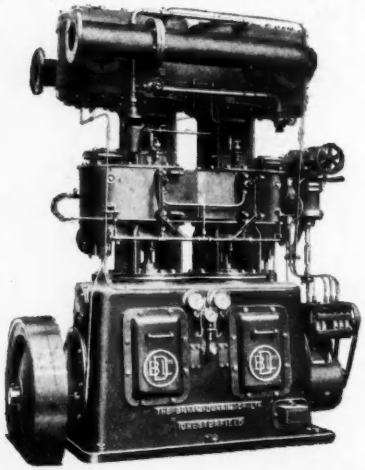

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